Heating Piping & Air Conditioning

APRIL 1958

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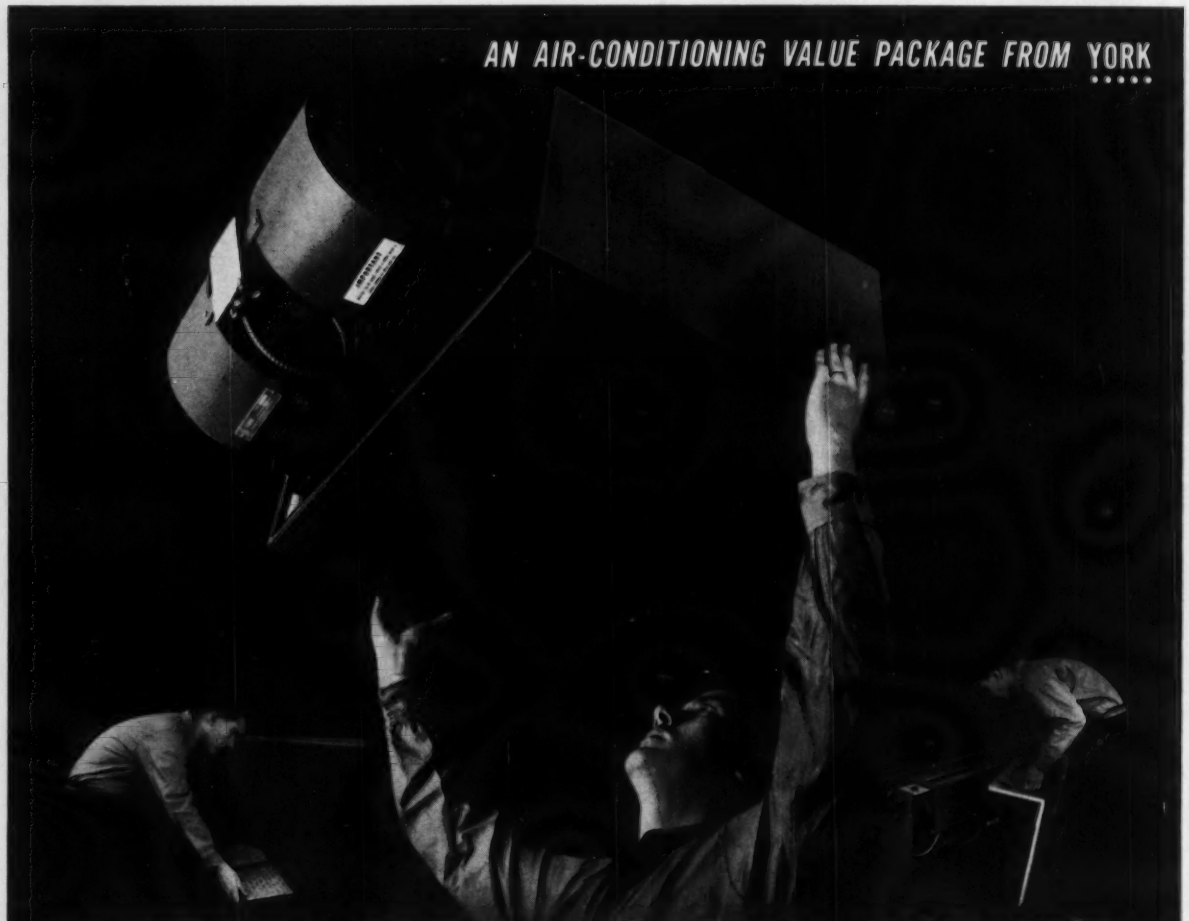
AN AIR-CONDITIONING VALUE PACKAGE FROM YORK



NEW FAN COIL UNIT

- **Easy, low-cost installation! Widest variety of mountings! Broadest selection of models in the industry!**
- **Entire unit covered by UL approval!**
- **Split-capacitor motors cut power consumption by as much as 40% . . . require fewer electrical circuits . . . have 30% greater life expectancy!**

Here's good news from York: a packaged fan coil unit that combines important engineering advances with real benefits of interest to mechanical contractors and consultants.

WIDER SELECTION! York is the only manufacturer offering a choice of floor, wall, and ceiling-mounted units . . . with decorative casings or furred-in enclosures. There are 20 models to choose from – the longest line in the industry.

SIMPLER INSTALLATION! Water supply, return and drain lines are the only piping required. No ductwork or central air equipment, of course. S.A.E. coil connections mean no sweat soldering. Left or right-hand hookups are interchangeable in the field. Wall and ceiling-hung units eliminate problems of levelling, carpet cutting and baseboard changes. Units and casings slide onto special hanger rails in seconds. There's no exposed wiring; flexible steel conduit is used throughout.

TOP-QUALITY PERFORMANCE! The UL label covers every model. Few competitive units offer this assurance of trouble-free service. Permanent split-capacitor motors are standard in York fan coil units. Their reduced power consumption permits more units per electrical circuit, fewer circuits per building. They run quieter, cooler, slower . . . assuring longer unit life, less maintenance.

THE PRICE IS RIGHT! From the moment York fan coil units arrive on site, they start saving time, money and headaches . . . for you *and* your client! That's because York designs with the *real cost* of air-conditioning in mind. The features listed above are just a few of the many you'll want explained in detail. Consult your classified directory for the name and address of your local York sales representative . . . or write for Bulletin I-216, York Corporation, York, Pa.

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CORPORATION
SUBSIDIARY OF BORG-WARNER CORPORATION

Millions Live Better with York

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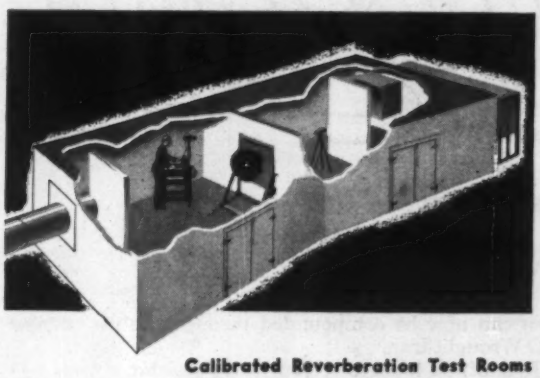
DON'T GROPE . . .

for factual fan sound power ratings



Calibrated Reverberation Test Rooms
Cutaway view of DeBothezat's noise evaluation reverberation test rooms, designed and calibrated by the acoustics staff of Armour Research Foundation.

COMPARISONS AND PAPERWORK can't provide the kind of data you need on the sound power output of fans. That's why DeBothezat built and equipped these modern testing facilities. These special facilities and equipment are used to log the sound power output of every DeBothezat fan, on *both* inlet and outlet sides.

Ratings on all DeBothezat fan units, measured as a complete assembly, are stated in both microwatts sound power and decibel sound pressure level in each of 8 octave bands of frequencies, measured separately. Next time you specify or install fans, ask your DeBothezat Sales Engineer for full information on the specific units considered.

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American Machine and Metals, Inc.
Dept. HP-458, EAST MOLINE, ILLINOIS

IN CANADA: Represented by DOUGLAS ENGINEERING CO., Ltd., Toronto • Montreal

Increasing deoxidation—a key step in the manufacture of new 4-D Wrought Iron.

Now—from Byers Research—
an even better Wrought Iron
for modern corrosion control—

new 4-D wrought iron

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New 4-D Wrought Iron is at least 25% *more* corrosion resistant than standard Wrought Iron—long an industry standard for superior corrosion resistance. This significant metallurgical advance is the result of 17 years of continuing research by Byers metallurgists.

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Heating Piping & Air Conditioning

Vol. 30, No. 4

(With which is merged the Aerologist)

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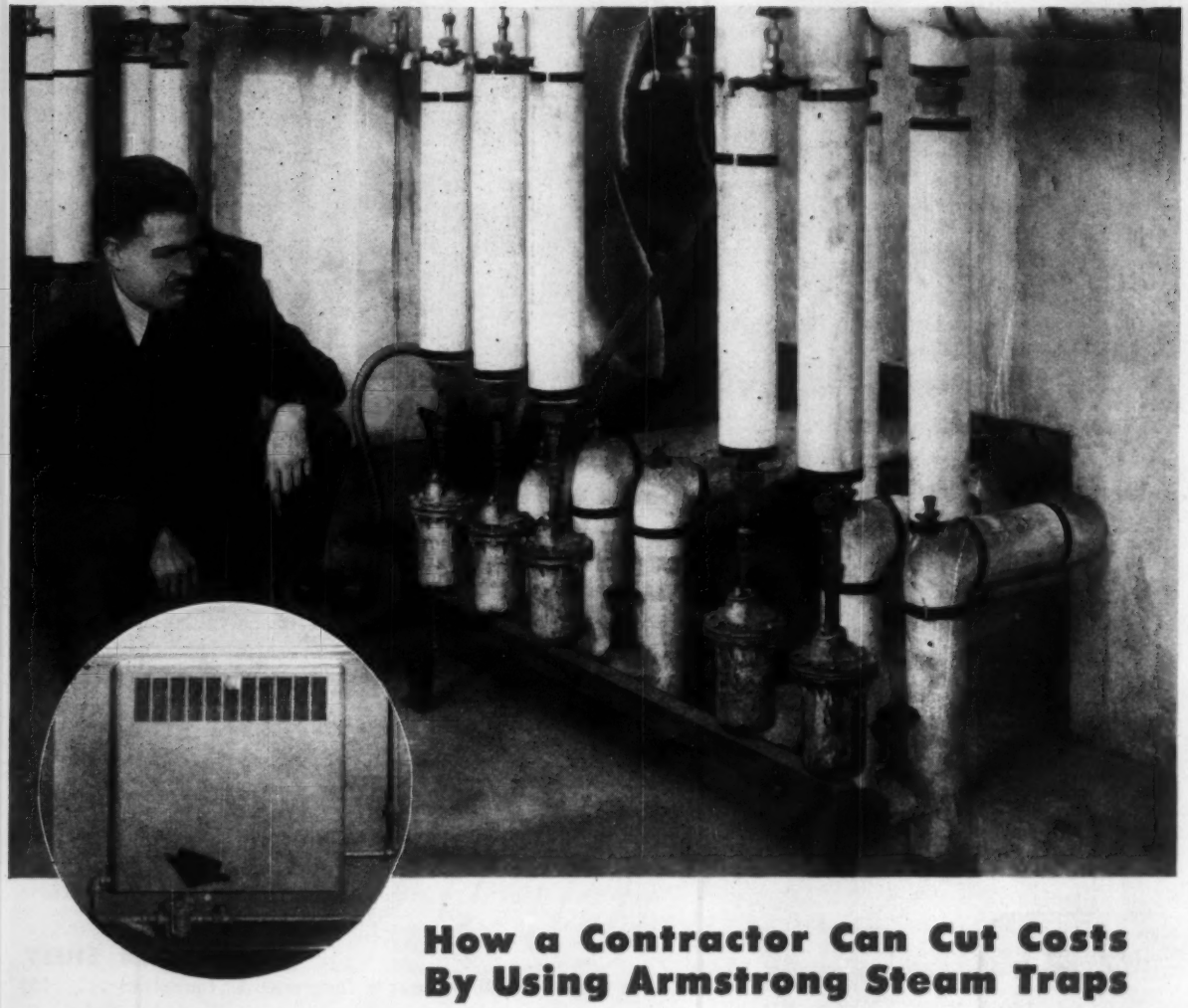

How a Contractor Can Cut Costs By Using Armstrong Steam Traps

● There is more than meets the eye in steam traps. If you don't regularly specify Armstrongs, you ought to know about these cost factors:

1. First Cost. The size and, hence, price of a trap is determined by its capacity. The high capacity of each Armstrong trap often enables you to select a size smaller than you would otherwise use.

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Connections. Armstrong offers you a choice of straight-through horizontal or vertical connections, as well as a right angle trap, to save fittings and labor.

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Check Valves. Here again, Armstrong offers a cost saving with a stainless steel, spring loaded internal check valve that is superior to external check valves.

3. Call-Back Cost. When you put in Armstrong traps, the job is done. The traps will work without attention, not just for a month or two or even a year, but *more commonly 3 or 4 or 5 years!* No traps have so enviable a record for low maintenance as Armstrongs because the mechanisms in low pressure traps are identical in design, workmanship and materials to those used in traps for 900 lbs. pressure, 900°F temperature.

Get the figures and the facts. Call your local factory-trained Armstrong Representative or write:

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How to Select and Install Steam Traps for Lowest Cost:

Here are two pieces of useful literature you should have—free on request:

1. Armstrong Steam Trap Book—44 pages of trap data, tables, hookup diagrams and selection information.

2. Unit Heater Trapping—trap selection and installation plus BTU output tables for every model of 30 makes of unit heaters.

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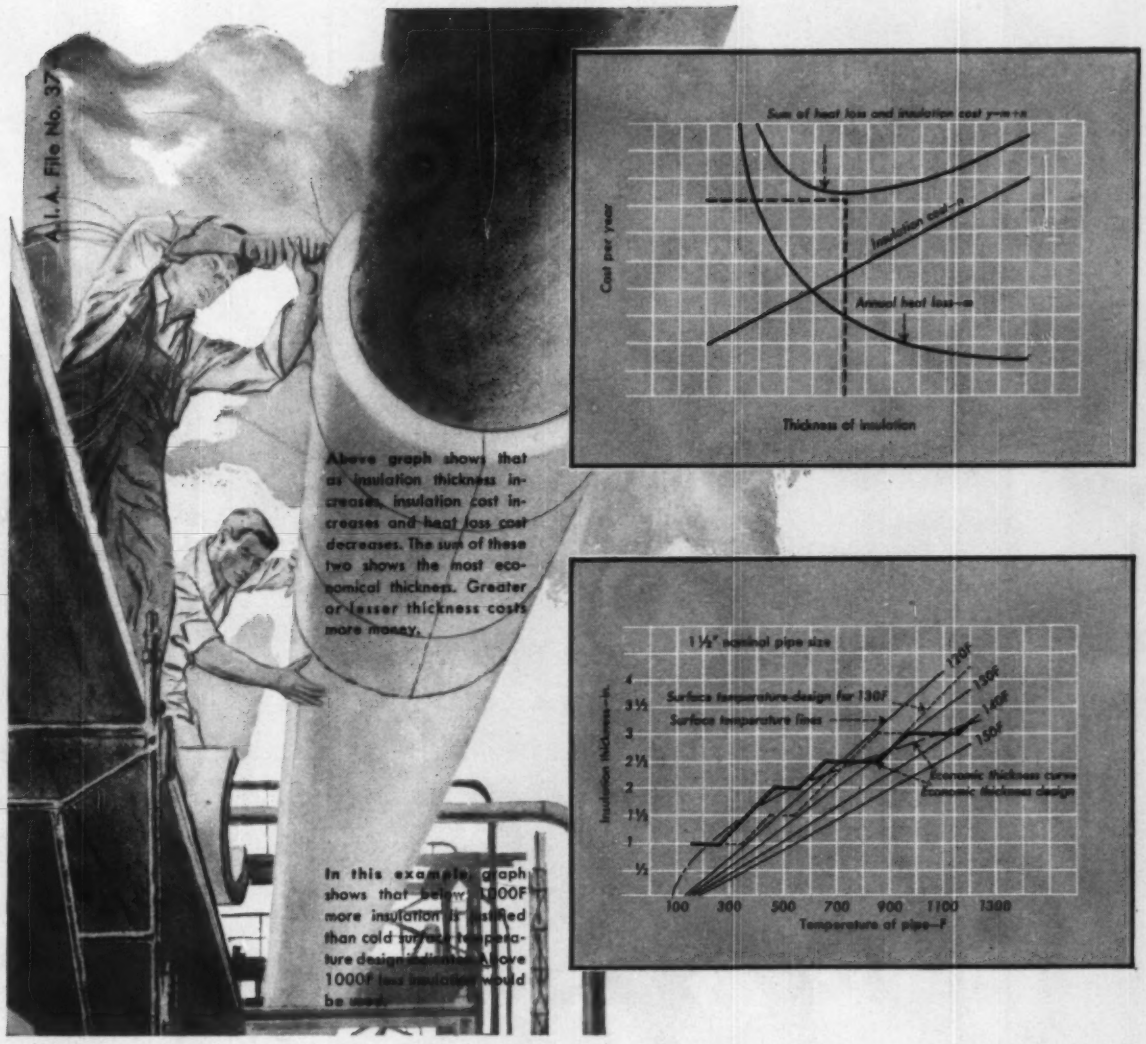
A.I.A. File No. 37
Above graph shows that as insulation thickness increases, insulation cost increases and heat loss cost decreases. The sum of these two shows the most economical thickness. Greater or lesser thickness costs more money.
Sum of heat loss and insulation cost y=n+a
Insulation cost—n
Annual heat loss—a
Cost per year
Thickness of insulation
In this example, graph shows that below 1000F more insulation is justified than cold surface temperature design method. Above 1000F less insulation would be used.
1½" nominal pipe size
Surface temperature design for 130F
Surface temperature lines
Economic thickness curve
Economic thickness design
Insulation thickness—in.
Temperature of pipe—F
100
300
500
700
900
1100
1300

"COLD SURFACE" CRITERION WASTES MONEY!

How J-M engineers determine economic insulation thickness

to give you more for your insulation dollar

OVER-ALL cost of the operation should always be the determining factor in selecting insulation thickness. Yet, millions of dollars have been wasted because of rigid adherence to the cold surface temperature method. When Johns-Manville insulation is applied, J-M engineers carefully determine which thickness will provide the greatest operational savings. And this "economic thickness" is usually more (or less) than the cold surface method indicates.

Here's how it works. The annual cost of the heat loss through the insulation is plotted for various thicknesses. Also plotted is the annual cost of insulation. A third curve is then drawn as the sum of heat loss and insulation cost. The economical thickness is found where this third curve reaches its lowest point.

To arrive at the above figures in a given instance requires the following: 1. Cost of heat production per million Btu; 2. Rate of heat loss through insulation in Btu per unit area per hr; 3. Annual hours of operation; 4. Applied cost of insulation per unit area; 5. Rate of amortization and required return on the insulation investment cost. Items 2 and 4 are available from the insulation manufacturer; others are normally supplied by the plant engineer.

For more complete information, call or write Johns-Manville, Box 14, New York 16, New York. In Canada, Port Credit, Ontario. Ask for reprint of technical article "Select Economic Insulation Thickness."

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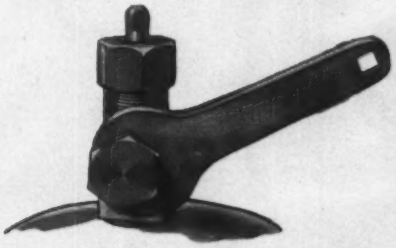
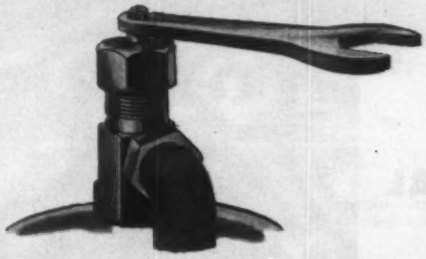


Use the Isotron Wrench As Cylinder Valve Stem Handle



You can get this useful, dual-purpose wrench FREE when you order Pennsalt Isotron from your distributor. One wrench given with *each* purchase of any size cylinder of Isotron Refrigerant 12 or Isotron Refrigerant 22. Offer—beginning April 1, 1958—good only while limited supply of wrenches lasts.

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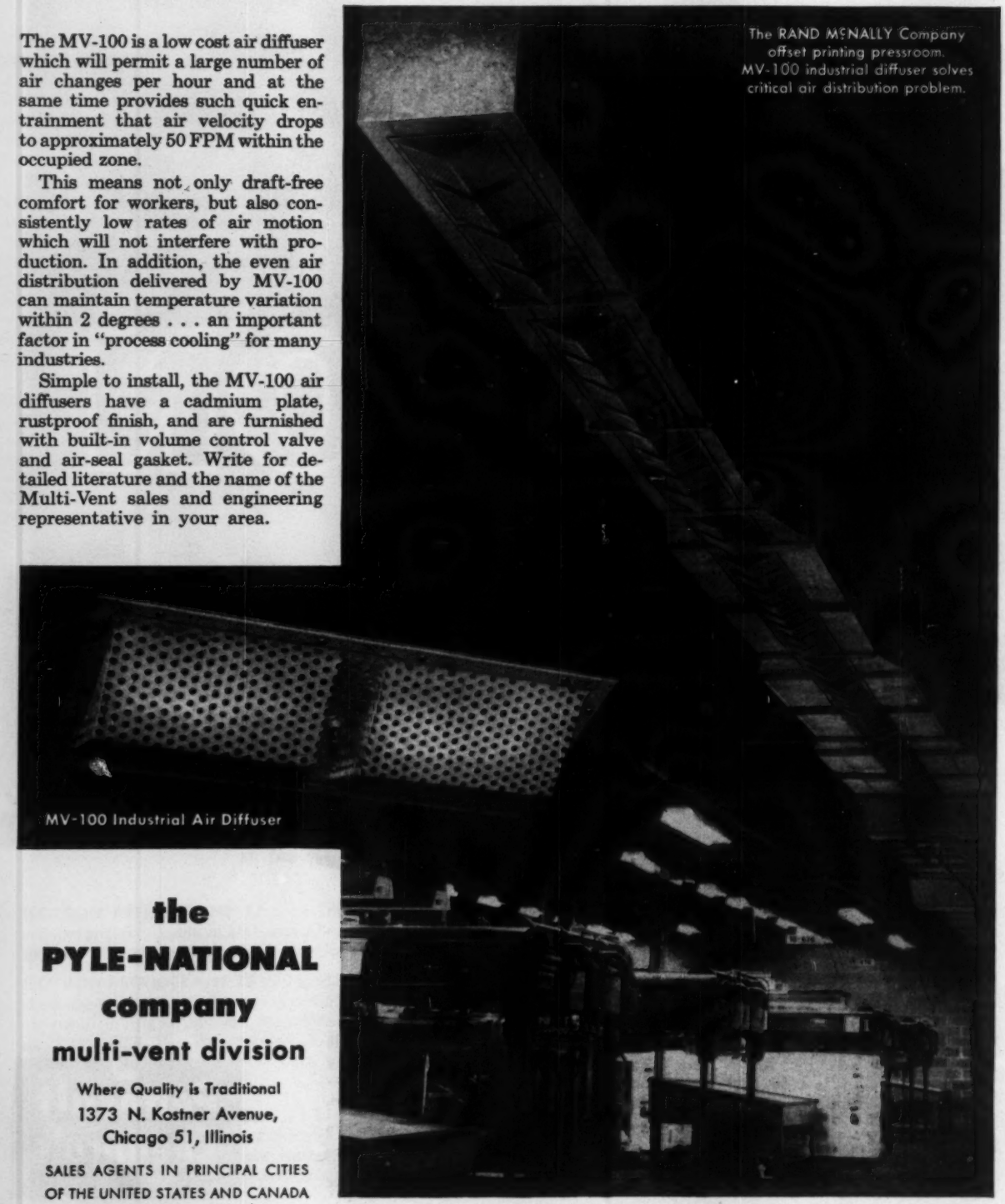

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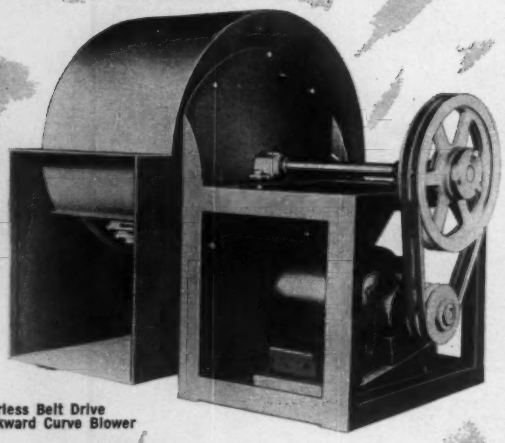
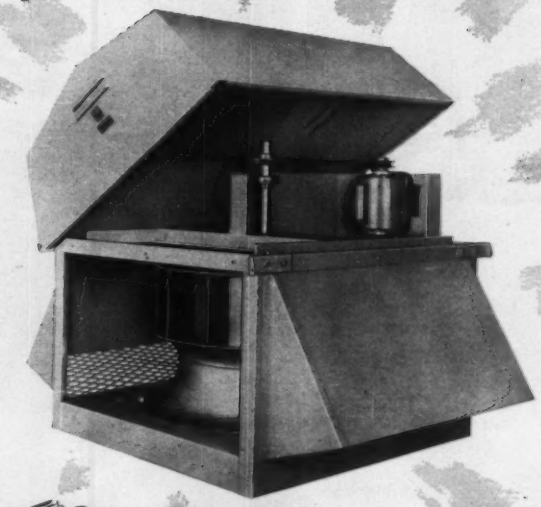


Peerless Belt Drive
Backward Curve Blower



Peerless Belt Drive
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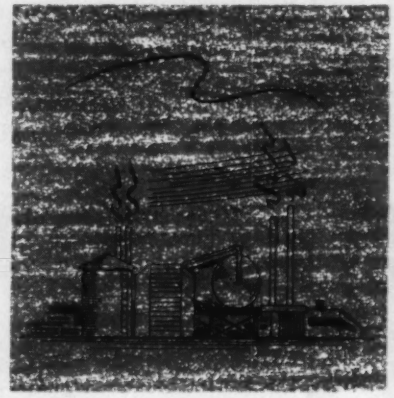
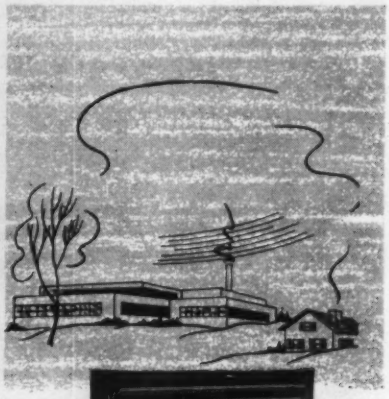
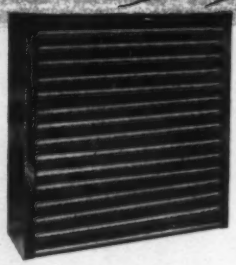


3—PURIFIES COMMERCIALLY CONTAMINATED OUTSIDE AIR (SMOG)



SPECIFICATIONS			
	No. 28	**No. 42**	**No. 52**
Size (Face Dimensions)	24″ x 24″	24″ x 24″	24″ x 24″
Depth (in dir. of Air Flow)	8¾″	8¾″	8¾″
Maximum Capacity	1000 CFM	700 CFM	1000 CFM
Carbon Bed Thickness	½″	¾″	½″
Approx. Weight of Carbon	36 lbs.	45 lbs.	45 lbs.
Resistance*	0.225″ WG	0.285″ WG	0.24″ WG
Efficiency	95%	95%	95%
Net Weight (cell only)	87 lbs.	92 lbs.	97 lbs.
Shipping Weight	110 lbs.	115 lbs.	120 lbs.

*The resistance of Dorex C Cells will not vary provided they are protected against dust accumulation.



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QUICK FACTS on GENETRON Super-Dry Refrigerants

- Guaranteed exceptionally low moisture content.
- Noncorrosive to standard equipment materials, nontoxic, nonflammable, stable, safe.
- Critical and freezing points well outside range of operating uses.
- Solvent action on oil helps prevent solidification or congealing of lubricant; aids in lubrication of equipment; generally miscible with oil.
- Freely interchangeable and may be mixed in any proportions with comparable fluorinated hydrocarbons meeting the same strict refrigerant specifications.
- Available everywhere, from refrigeration wholesalers throughout the country.

GENETRON 11 ORANGE LABEL CCl_3F
Trichloromonofluoromethane

GENETRON 12 WHITE LABEL CCl_2F_2
Dichlorodifluoromethane

GENETRON 22 GREEN LABEL $CHClF_2$
Monochlorodifluoromethane

GENETRON 113 PURPLE LABEL $C_2Cl_3F_3$
Trichlorotrifluoroethane

GENETRON 114a BLUE LABEL $C_2Cl_2F_4$
Dichlorotetrafluoroethane

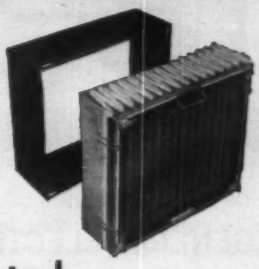
Allied Chemical

GENERAL CHEMICAL DIVISION
40 Rector Street, New York 6, N.Y.

Connecticut General Life Underwrites Better Air

Architects: Skidmore, Owings & Merrill; Interior Designer: Knoll Associates, Inc.; Engineers: Weiskopf & Pickworth (structural) Syska & Hennessy, Inc. (mechanical, electrical); Consultant: BUILDING METHODS & MATERIALS: Walter C. Voss; Acoustical Consultant: Bolt, Beranek & Newman; Sculpture: Isamu Noguchi; General Contractor: Turner Construction Co.

with AAF FILTERS!



Airmat PL-24 filters selected for all-important air cleaning job

The new home office building of Connecticut General Life Insurance Company in Bloomfield is, without question, one of the outstanding architectural designs of the decade. Complete with artificial lake and a dining wing that overhangs a reflective pool, the building was designed with Connecticut General's *people* in mind. Virtually all of the Company's 2000 home-office employees are within 35 feet of a window, looking out on either a garden court or an expanse of the 275-acre tract in its natural state.

An important part of this "design for people" was clean air. The men who designed and built this striking building gave the same care and attention to the selection of air filters that was given to every other detail. From AAF's complete filter line, they selected the Airmat PL-24 to provide 650,000 cfm of better air.

The Airmat PL-24 is the world's most efficient mechanical filter for ventilating and air conditioning service. It packs 28½ square feet of filtering area into a compact 2′ x 2′ x 8″ unit . . . features low-cost renewable paper media and unit construction for simplified maintenance. For complete information on the Airmat PL-24 renewable-media air filter, call your local American Air Filter representative or write direct for AAF Bulletin No. 230.

AAF Dust Control Equipment

Illinois Heating Specialties

AAF Herman Nelson

American Air Filter
COMPANY, INC.

373 Central Avenue, Louisville 8, Kentucky
American Air Filter of Canada, Ltd., Montreal 9, P. Q.

BETTER AIR IS OUR BUSINESS

Herman Nelson Unit Heaters

Herman Nelson Unit Ventilators

CASE #101—Another case where General Electric Factory-Assembled Air Conditioning Units proved more economical than field-assembled systems.

Galt Ocean Mile Hotel—Fort Lauderdale's newest and largest, built by the Atlantic Const. & Eng. Co., Ft. Lauderdale—provides the finest, most luxurious and congenial accommodations—including General Electric Zone-by-Zone Air Conditioning.

GENERAL ELECTRIC **ZONE-BY-ZONE AIR CONDITIONING** SAVES FORT LAUDERDALE'S NEWEST, LARGEST HOTEL $50,000 INITIALLY—SPACE WORTH $3,000 ANNUALLY IN RENTALS

When the beautiful new Galt Ocean Mile Hotel, Fort Lauderdale, Fla., chose General Electric Zone-by-Zone Air Conditioning over a field-assembled central station system—it scored three ways in economy.

(1) Owing to simplified installation, an initial saving of $50,000 was accomplished. (2) Space saved is worth $3,000 a year in rentable room space. (3) Further savings are achieved through General Electric's individual zone control—enables management to cool only the areas it wants when it wants—servicing of one unit in no way interferes with the performance of the others. Meanwhile, the comfort, cleanliness and quiet operation of this General Electric system is one of the major guest-pleasing attributes of the hotel. This is another typical example of how General Electric Factory-Assembled units meet the most exacting air conditioning requirements economically and efficiently.

General Electric's complete line is flexible enough to meet every air conditioning need for all buildings—large or small—old or new. Ceiling-mounted units water-cooled up to 7½ tons—air-cooled up to 10 tons. Floor-mounted units—water-cooled up to 30 tons—air-cooled up to 20 tons. Steam and hot water coils available for all models. Discover how General Electric Factory-Assembled Units can simplify your planning. For full details write: General Electric Company, Commercial and Industrial Air Conditioning Department, Bloomfield, New Jersey.

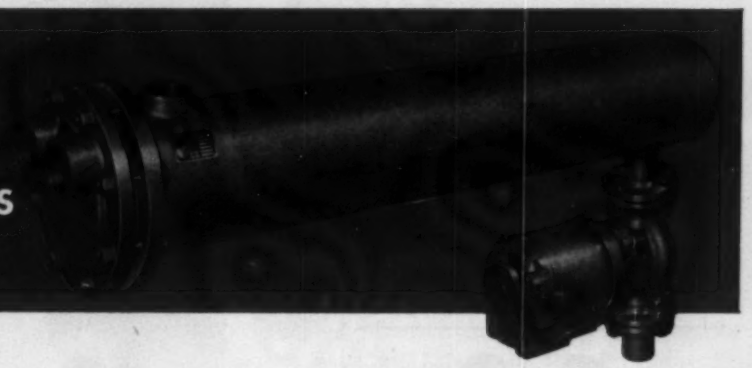
Progress Is Our Most Important Product

GENERAL ELECTRIC

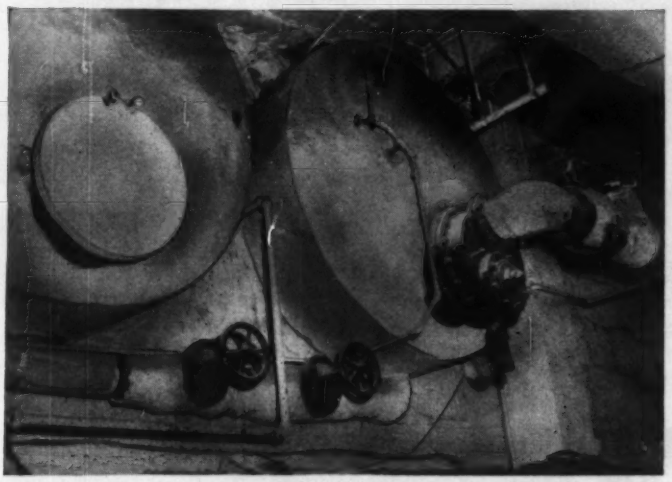
In Canada, Canadian General Electric Co., Ltd., Montreal

B&G®

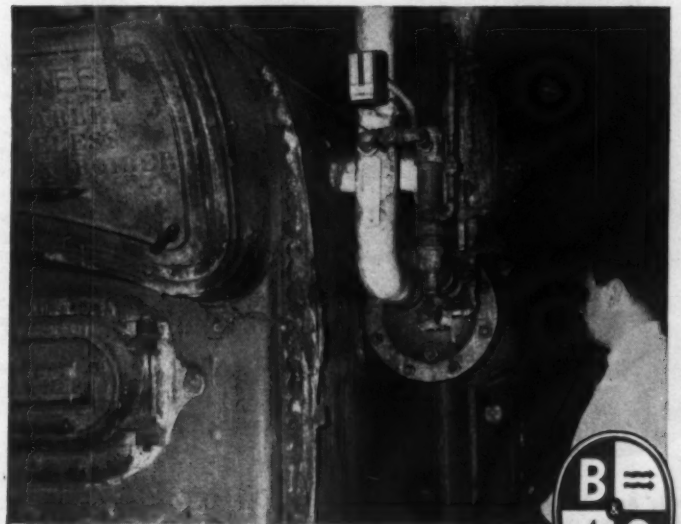
"WU" INSTANTANEOUS WATER HEATER



SAVES REPLACING EXPENSIVE HOT WATER STORAGE TANKS



THE PROBLEM: *How to economically replace two leaking hot water tanks.*



THE SOLUTION: *Old tanks were capped off and a compact B&G Type "WU" Instantaneous Water Heater connected to the boiler.*

The photos here show a practical, inexpensive remedy for a common trouble. The "Problem" picture shows two old-fashioned hot water storage tanks, requiring replacement because of leakage...the "Solution" picture, how the tanks were replaced with a modern B&G Instantaneous "WU" Heater.

To remove and replace the two leaking hot water tanks would have been a difficult and costly job. Installing a comparatively tiny B&G Type "WU" Heater *saved hundreds of dollars* and in addition *increased the available volume of hot water!* In 12 years of operation there has never been a shortage of hot water.

Why the B&G "WU" Heater saves space and money

The "WU" comes equipped with a B&G Booster Pump which pumps boiler water through the shell, greatly increasing the capacity of the heater. Large volumes of hot water are produced by amazingly small units.

The Booster is controlled to start whenever water temperature goes below the desired degree. Boiler water is pumped through the shell of the "WU" until service water is again at the correct temperature.

The "WU" Heater can be installed on hot water boilers or below the water line of steam boilers.

Send for this booklet on the application, selection and installation of B&G Instantaneous Water Heaters.

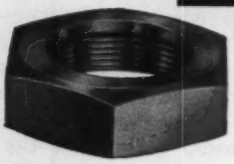
*Reg. U.S. Pat. Off.

BELL & GOSSETT
COMPANY
Dept. FF-5, Morton Grove, Illinois
Canadian Licensee: S. A. Armstrong, Ltd., 1400 O'Connor Drive, Toronto 16, Ontario

Toothed Lock Washer: Prevents loss of stem nut due to vibration, thereby holding the handwheel securely.

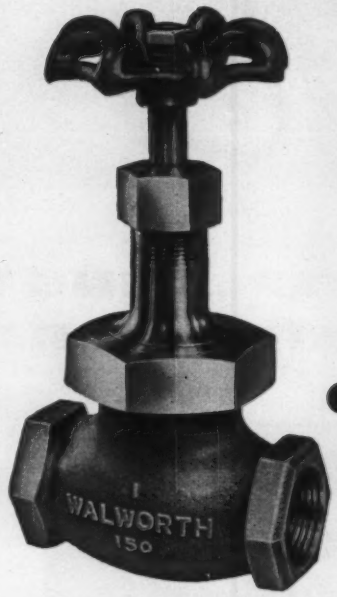
Newly Designed Handwheel: Air-cooled, finger grip handwheel affords sure grip even with greasy gloves.

Improved Packing: Molded packing of lubricated asbestos reinforced with copper wire. Suitable for practically every service. Valves can be repacked under pressure.



Hexagonal Union Bonnet Connection: Eliminates any chance of distortion or leakage even though valve is repeatedly taken apart and assembled.

WALWORTH



IMPROVED

No. 95 BRONZE GLOBE VALVE

also available in Angle Type (No. 96)

The service ratings of the Walworth No. 95 are 150 pounds per square inch steam at 500F, and 300 pounds per square inch non-shock cold water, oil, and gas. In the manufacture of this quality bronze valve, more than 47 gages are used in machining parts to micrometric accuracy, thus insuring interchangeability of parts. For further information see your local Walworth distributor, or write: Walworth Company, 750 Third Ave., New York 17, N.Y.

note these 7 Great Features

WALWORTH

valves and fittings

750 THIRD AVENUE NEW YORK 17, N. Y.

DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD

New Cylindrical Disc Holder: The design of the top portion of the disc holder keeps the disc accurately guided under all operating conditions.

Renewable Asbestos Disc: This disc is suitable for steam up to 500F and is resistant to oil, gasoline, and many chemicals at atmospheric temperatures. Discs for special services are available.

Extra Strong Body: Made of Composition M (ASTM B61) bronze thick enough to provide a high safety factor. Valves undergo hydrostatic shell test of 450 psi.

Comfortable students are better students at Washburn University

air conditioned by

McQuay SEASONMAKERS

Comfortable students are receptive, alert students eager to learn. The New Margaret Mulvane Morgan Memorial is air conditioned by 112 McQuay floor type Seasonmaker units to provide the finest low cost and economical year 'round comfort. There is a McQuay unit especially designed for every type and every size heating and air conditioning job—old or new, large or small. Each has the inherent built-in quality and dependability for which McQuay has been famous for more than a quarter century. Consult your McQuay representative or write McQuay, Inc., 1601 Broadway St. N. E., Minneapolis 13, Minn.

Typical classroom, showing McQuay floor type Seasonmaker air conditioning units.

Margaret Mulvane Morgan Memorial, Washburn University, Topeka, Kansas
Architects: Thos. W. Williamson and Victor H. Loebsack & Assoc., Topeka
General Contractor: M. W. Watson, Topeka; Plumbing and Heating: Sheahan and Degan, Topeka

FLOOR TYPE SEASONMAKER—for free standing floor mounting. four sizes, 200 to 600 cfm, ½ to 2 ton nominal cooling capacity. Both thermally and acoustically insulated. Choice of three air discharge grilles.

HIDEAWAY TYPE SEASONMAKER—for concealed, suspended mounting in closets, attics or furred spaces. Seven sizes, 200 to 2000 cfm, ½ to 5 ton nominal cooling capacity. Insulated drain pan.

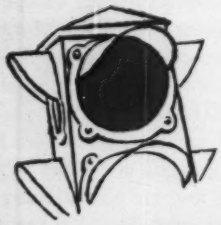
CEILING TYPE SEASONMAKER—for suspended mounting. Seven sizes, 200 to 2000 cfm, ½ to 5 ton nominal cooling capacity. Thermally and acoustically insulated.

BASIC TYPE SEASONMAKER—for fully recessed built-in wall installations. Four sizes, 200 to 600 cfm, ½ to 2 ton nominal cooling capacity. Thermally and acoustically insulated.

McQuay Means Quality

McQuay INC.

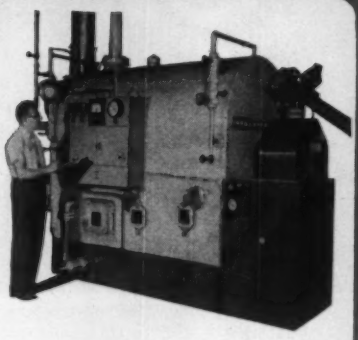
AIR CONDITIONING
HEATING
REFRIGERATION



STOP and SEE!

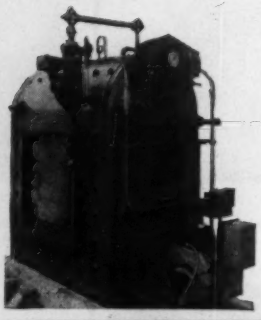
3 Better WATER TUBE Package Units by INTERNATIONAL

the COAL-PAK AUTOMATIC



First FULLY AUTOMATIC package unit complete with combustion controls, automatic coal feed and ash removal system, for burning LOW COST BITUMINOUS COAL cleanly and efficiently.

Write for Bulletin 1100

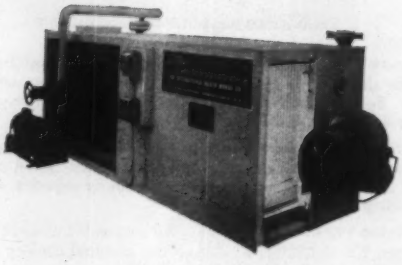


the COMPAK

First FORCED DRAFT water tube package unit with a price tag EQUAL TO OR BELOW firetube scotch package boilers. For low or high pressure requirements, oil or gas fired.

Write for Bulletin 1200

the THERMOJET



First FORCED RECIRCULATION package unit that actually requires LESS HEADROOM than modified scotch package boilers. Famous LA MONT boiler design specifically adapted for SINGLE BUILDING low or high temperature water heating systems.

Write for Bulletin 1000

Get the facts from your INTERNATIONAL DISTRICT REPRESENTATIVE or write for Bulletins listed above

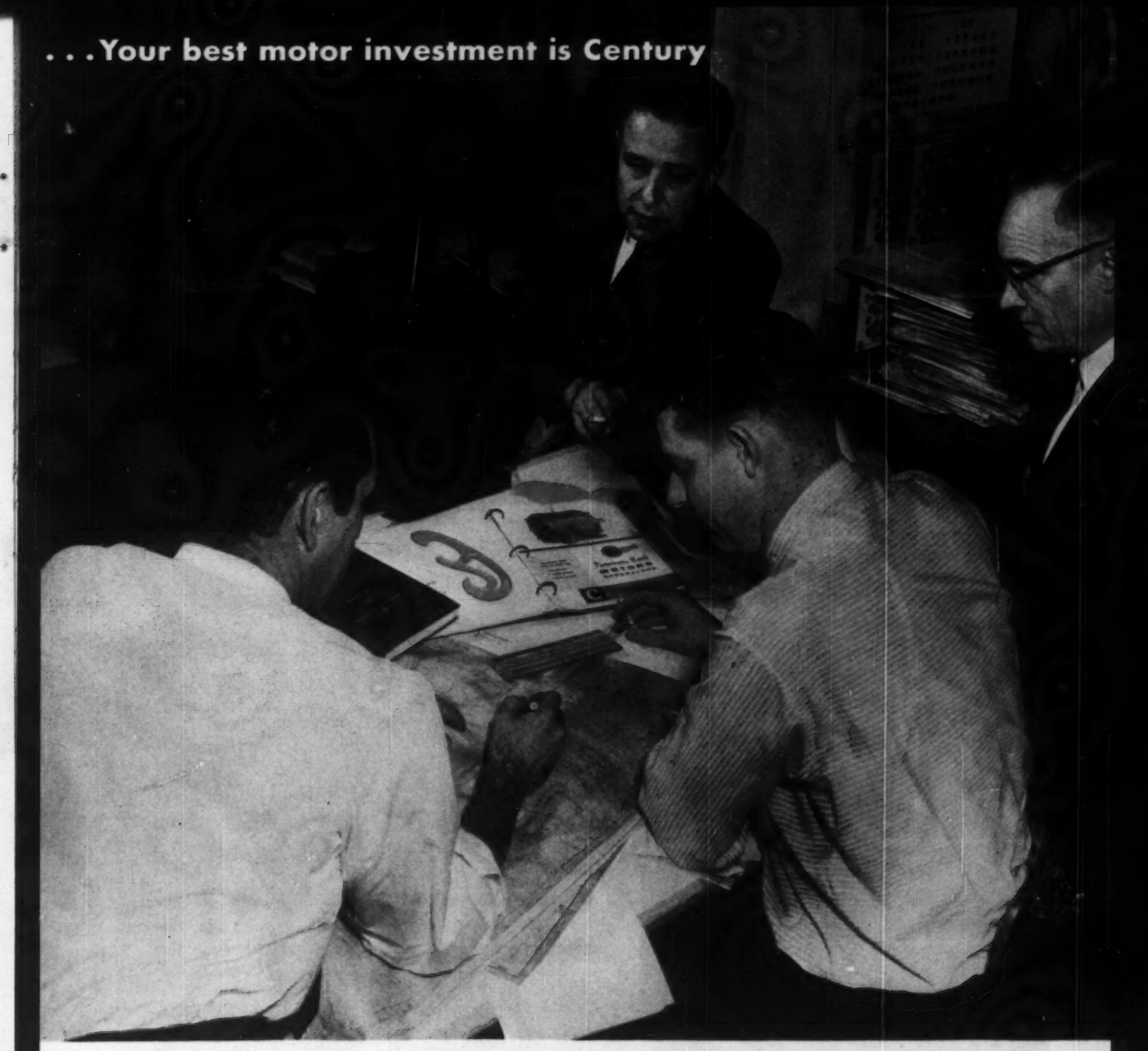
IBW

BOILER BUILDERS SINCE 1886

THE INTERNATIONAL BOILER WORKS CO.

810 Spruce St. East Stroudsburg, Pa.

Steel Firebox Heating & Power Boilers · Low & High Pressure Water Tube Package Boilers · International-LaMont Forced Recirculation Generators · ASME Code Pressure Vessels & Welded Products



Specify Century for top performance in motor-driven equipment

The performance and acceptance of equipment in the field can depend on the motor that drives it. And the design of motor-driven equipment is not complete until the motor is specified. This involves careful consideration of motor type and of motor manufacturer as well.

A familiar scene in the engineering departments of leading equipment manufacturers finds Century Application Engineers helping to determine the correct motor for the job. They are often called in during the design and development stage. Through their know-how and experience they help select the motors to match the performance of the equipment.

Century motors write their own record of reliability. Get all the facts on why Century is your best motor investment. Call your local Century man or Authorized Century Distributor.

Century MOTORS

CENTURY ELECTRIC COMPANY

St. Louis 3, Missouri • Offices and Stock Points in Principal Cities

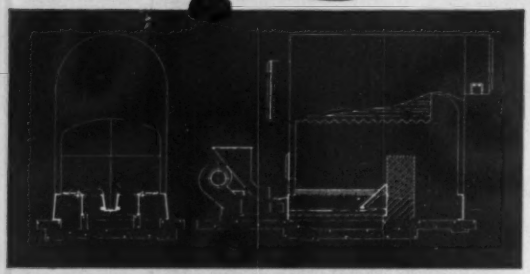
DETROIT LoSTOKERS

Efficiently Fire Small Boilers

AVAILABLE FOR EITHER FIREBOX OR BRICKSET APPLICATIONS . . .

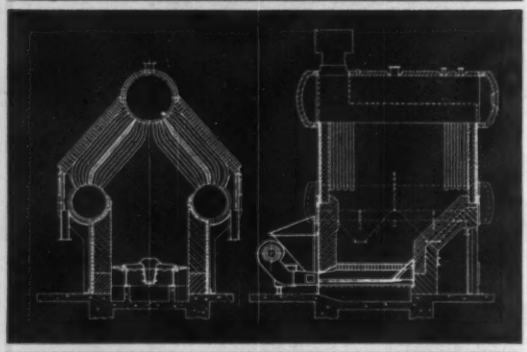
Capacity Range 3,000 to 12,000 Pounds of Steam per Hour
Save Coal—Save Labor—Eliminate Smoke

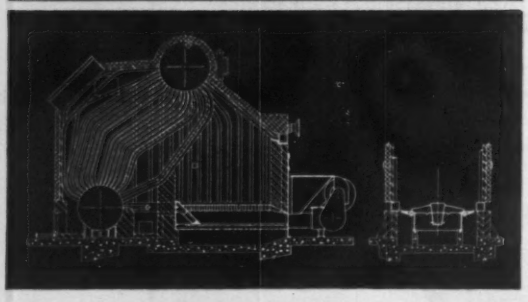
For Brickset Applications



Regulation Connects Here

For Firebox Applications





A complete mechanical firing unit. The Detroit LoStoker is efficient, dependable and built for long life. Requires little power for operation, may be driven either by motor or steam turbine, under automatic control.

Optional regulation is "Start and Stop" or "Full Floating Control". With "The Detroit Adjustable Feed Control", the plunger always operates on a full stroke, which assures uniform distribution at all capacities.

Where furnace volume permits, the LoStoker may be installed directly in firebox boilers, without front or side-wall brickwork.

Typical applications to small boilers are shown.

WRITE FOR RECOMMENDATIONS · NO OBLIGATION

DETROIT STOKER COMPANY
MAIN OFFICE AND WORKS • MONROE, MICHIGAN
District Offices or Representatives in Principal Cities

SAVE COAL • SAVE LABOR • ELIMINATE SMOKE

RELIABLE VENTILATION IN A PACKAGE

"Buffalo" Belted Vent Sets

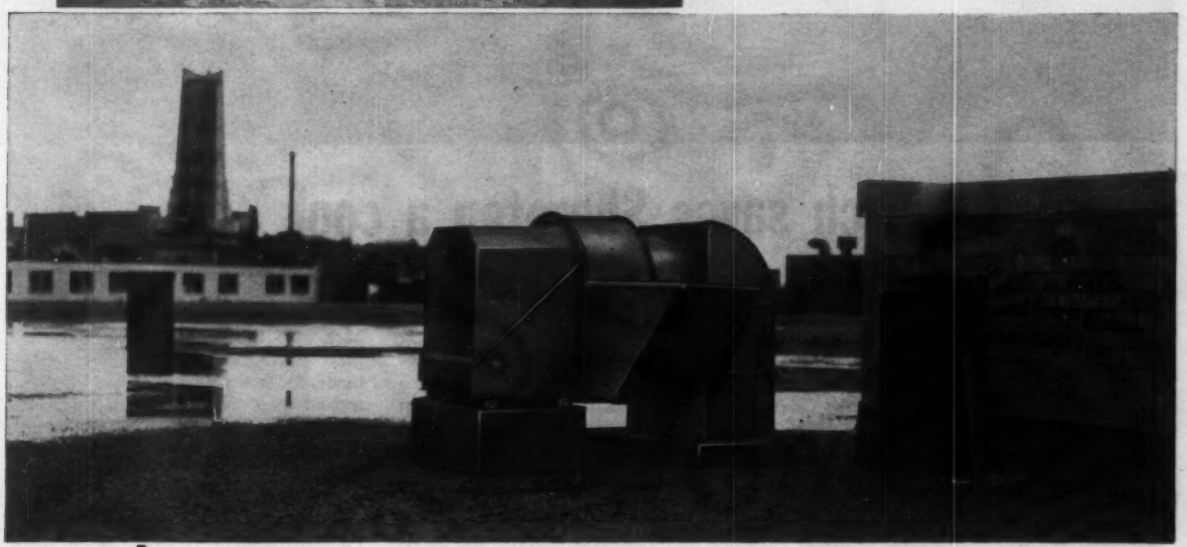
Quiet, ruggedly constructed and compact, "Buffalo" Belted Vent Sets are equally adaptable to indoor or outdoor installations. Double-curved blades prevent overloading. Inlet vane design reduces turbulence and air noise. Insures quiet, stable fan operation, even under unfavorable inlet conditions. Available with all-weather drive cover for roof or other outdoor installations. Capacities range from 500 to 20,000 cfm. Adjustable pitch motor sheaves permit variable capacity.

For full information, write for Bulletin 3720-A.

SPECIAL FEATURES AVAILABLE

All-Weather Cover and Rain Shield. Drain Connection in bottom fan housing. Access Door in scroll. Inlet and Outlet Screens. Non-sparking Aluminum Wheels. Enclosed or Explosion-Proof Motors. Ball Bearing Motors. Anti-Vibration Pads. Stainless Steel or Aluminum Construction for Units having all parts in contact with gas or fumes. Belt Guard. Gravity Type, Hand-Operated or Motor-Operated Outlet Shutters. Special Protective Coatings on Inside Housing and Wheel.

All "Buffalo" products feature the famous "Q" Factor—the built-in Quality that assures trouble-free satisfaction and long life.



VENTILATING
AIR CLEANING
AIR TEMPERING
INDUCED DRAFT

BUFFALO FORGE COMPANY

EXHAUSTING
FORCED DRAFT
COOLING
HEATING
PRESSURE
BLOWING

BUFFALO, N.Y.

Buffalo Pumps Division, Buffalo, N. Y.

Canadian Blower & Forge Company, Ltd., Kitchener, Ont.

"Buffalo"

B.F.Goodrich

B. F. Goodrich saves Sheraton a cool $9,517.26

Philadelphia's new Sheraton boasts 8,100 feet of B. F. Goodrich Cell-Tite Tubing on water lines of 1,000 room air conditioners, and for good reason!

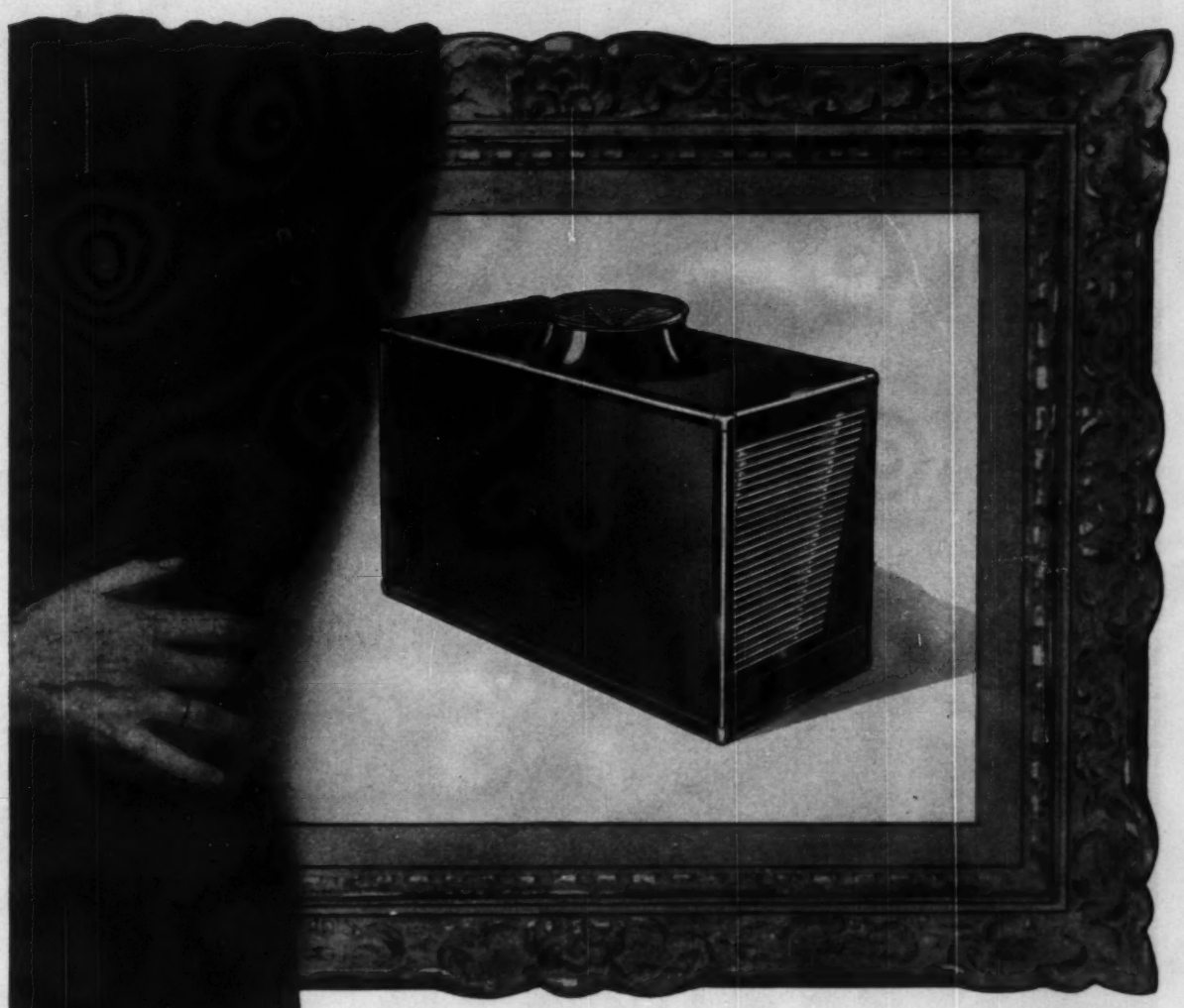
Saves labor costs: "With B. F. Goodrich Cell-Tite Tubing," says Mr. Earle Baltz, executive of Achenbach & Butler, Inc. insulation specialists, "we cut the time needed to put insulation on two lengths of pipe from a normal three hours to only 20 minutes. This individual saving of two hours and forty minutes became a saving of 2,666 man-hours on the whole job. Labor on this cost $3.57 per hour—multiplied by the total time, making a saving of $9,517.26!"

Why they selected B. F. Goodrich Cell-Tite: "It effectively prevents condensation on pipes carrying cold water through warm areas, holds heat of hot water in pipes. The material suffers no effects from constant exposure to maximum heat rating . . . continually holds up under heats approaching its rated 220° resistance, has a K factor of 27 giving maximum insulation without undue thickness, is consistent and uniform in quality and assures even all-around insulation by being of 'closed-cell' construction."

Easy to install: "This tubing cuts labor costs by easy-threading on pipe, fits around bends, gives a much neater appearance. To strip the ends, we held the tubing back clear of the connection, held it in place with wire. After the connection was made, the wire was cut and the insulation moved over the exposed section. Even after being wired in a compressed position for two months, the tubing showed no permanent set!"

Get free booklet: For complete information and free booklet write The B. F. Goodrich Company, 481 Derby Place, Shelton, Connecticut.

B.F.Goodrich
insulation tubing



Marley proudly presents the

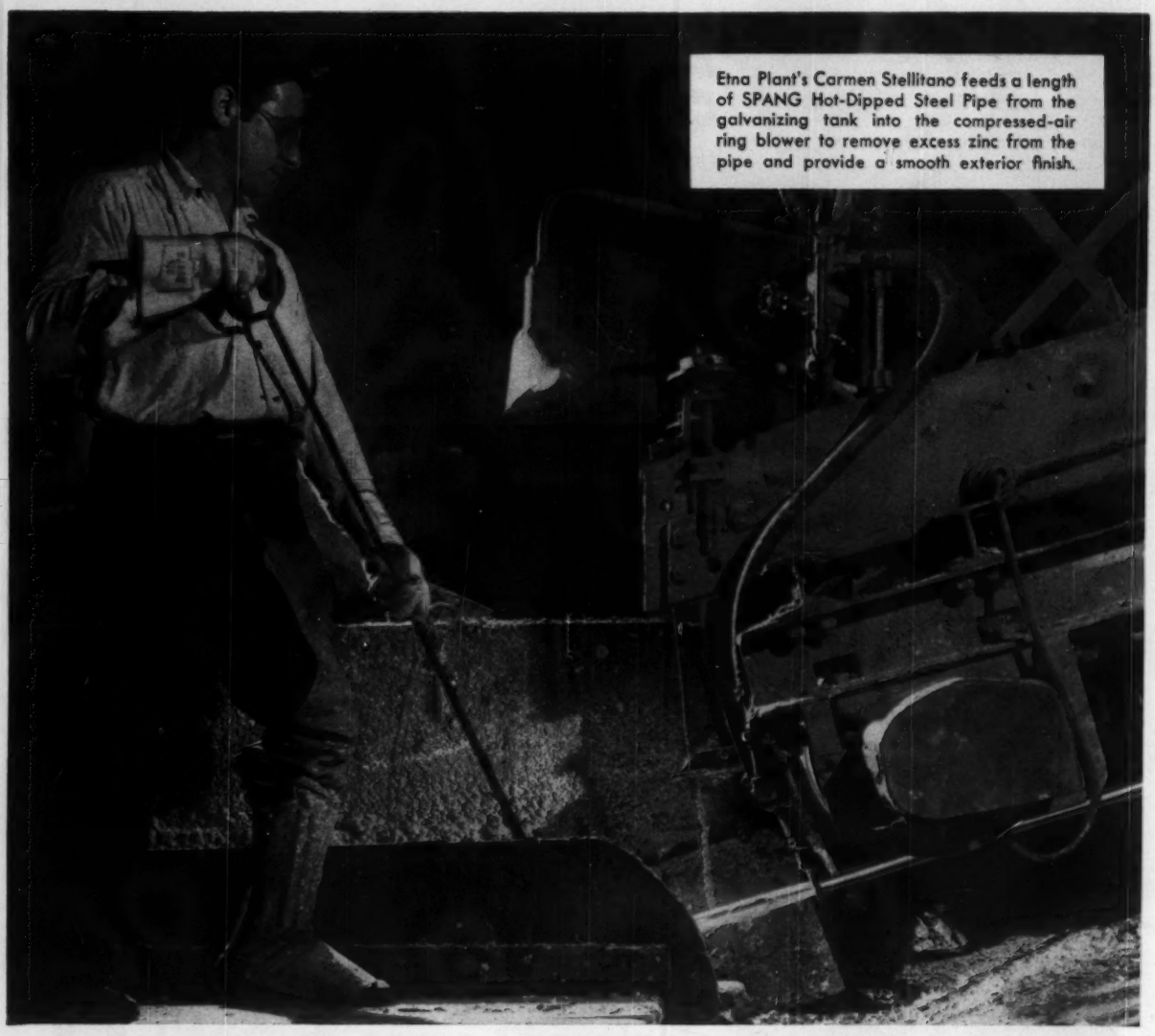
PERMATOWER

Engineered in the light of modern technology, PERMATOWERS are a new approach to cooling tower durability under any service conditions. To combat corrosive influences of all types, their design extends the use of reinforced polyester, phenolic and Kralastic type resins and protected laminates to many heretofore vulnerable points.

In a full range of 11 capacity models, PERMA-TOWERS will soon be presented to the market by Marley sales engineers and distributors.

The Marley Company

Kansas City, Missouri



Etna Plant's Carmen Stellitano feeds a length of SPANG Hot-Dipped Steel Pipe from the galvanizing tank into the compressed-air ring blower to remove excess zinc from the pipe and provide a smooth exterior finish.

Out of this galvanizing tank comes the best steel pipe* you can buy!

...*Spang, of course!

AND HERE'S WHY...

UNIFORM STRENGTH—SPANG Steel Pipe is produced under close control during forming and welding to provide a uniform pipe that's easy to cut, bend and thread . . . and it's hydrostatically tested well above normal operation pressures to be sure you get a strong pipe for rugged use.

HEAVY-DUTY UNIFORM FINISH—of prime western zinc, air-wiped outside to produce a smooth, even finish that will stand up under severe bending strains . . . blown inside with superheated steam to provide a smooth finish for easy flow of liquids.

HIGH CORROSION RESISTANCE—Quick quenching of the hot galvanized pipe in a sodium dichromate solution gives a strong bonding of the finish to the steel . . . helps retard formation of white rust . . . adds extra service life to the pipe.

SPANG-CHALFANT
DIVISION OF
THE NATIONAL SUPPLY COMPANY
General Sales Offices: Two Gateway Center, Pittsburgh, Pa.

SPANG®
CW STEEL PIPE

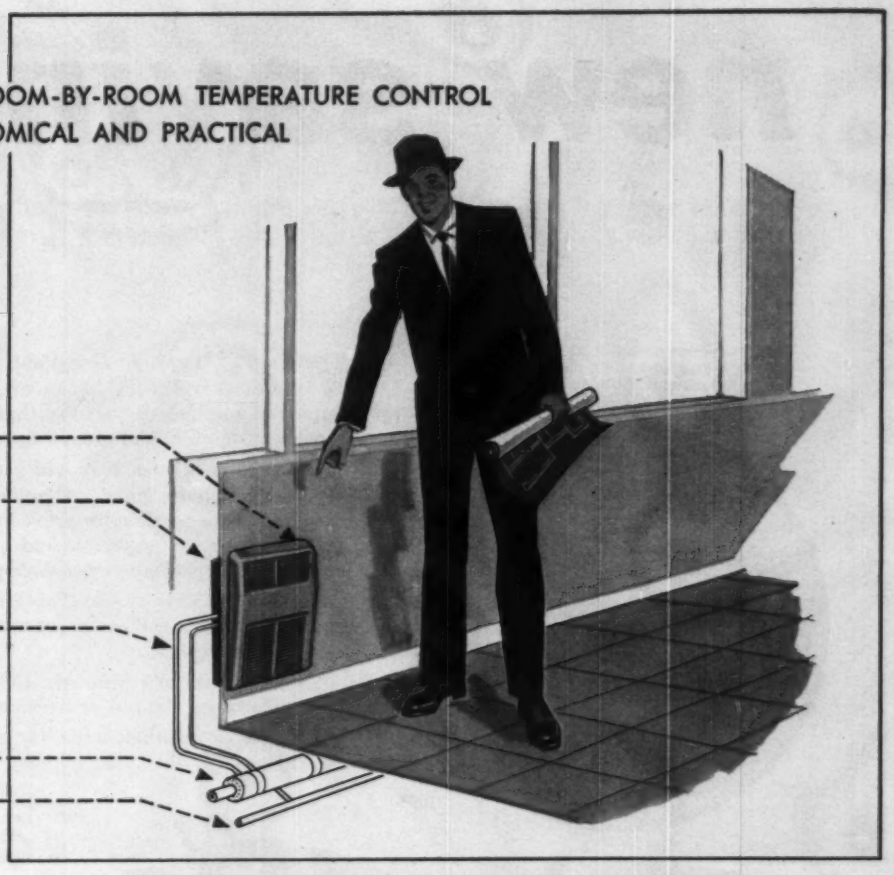
District Sales Offices: Atlanta, Boston, Detroit, Houston, Los Angeles, New York, Philadelphia, Pittsburgh, St. Louis

NEXT JOB MAKE IT SPANG® STEEL PIPE!

It's ideal for any piping installation, especially drainage and vent lines. You'll get quality every time. Save money in the long run, too! There's a SPANG Distributor near you, ready to give you quality service on your order.

ACCURATE ROOM-BY-ROOM TEMPERATURE CONTROL
NOW ECONOMICAL AND PRACTICAL

IRON FIREMAN
SelecTemp®
HEATING


THERMOSTAT
AIR HEATING, FILTERING AND CIRCULATING UNIT
Each room heater is an automatic unit, with steam heating core, air filter, steam driven fan and non-electric thermostat. Recessed in wall, requires no floor space.
COPPER TUBING
Low first cost. Substantial installation savings in new or existing construction. Flexible copper tubing concealed in walls and floors. Uses low pressure steam from boiler or district steam.
STEAM SUPPLY
CONDENSATE RETURN

New answer to old heating problems

The problem of room temperature control. SelecTemp heating is a new application of steam heat in which heat from a central source (low pressure boiler or district steam) is automatically regulated in each individual room. Temperature control is very accurate.

The problem of balanced heat. The warm and cool sides of a building are uniformly heated. A thermostat in each room automatically regulates heat according to room needs, compensating for any exterior or interior heat loss or gain resulting from wind, sun, fireplace, or a varying number of occupants.

The problem of varied temperatures for varied activities. In a school, for example, SelecTemp meets the different needs of classrooms, gymnasium, library or shop.

The problem of space. SelecTemp uses no floor space; compact room units, only 18" high, are recessed into walls. Steam supply and return lines of small copper tubing are concealed in walls and under floors. Extra space is not required for ducts or rigid pipes, permitting unusual design freedom, and in most cases, savings in construction costs.

The problem of modulated heat. Air circulation is steady. Temperature is controlled by regulating the amount of warmth delivered—not by stop-and-go cycling. Temperature is remarkably uniform from floor to ceiling and from corner to corner.

The problem of economy. With all its advantages, SelecTemp costs no more than many conventional systems not providing this unique automatic temperature control of each room. Fuel is saved because unoccupied rooms can be kept cool and reheated in a few minutes. Occupants do not waste heat through open windows. SelecTemp heating is equally suited for use in both new and existing construction.

SELECTEMP ROOM HEATER SPECIFICATIONS

	Model H-6	Model H-12	Model H-18
Output, Btu/hr at 10 PSI	6,000	12,000	18,000
Wall opening	17"x 6¾"	17"x 11"	17"x 15½"
Air Vol. CFM	60	120	180
Room heater supply line from main	⅜" O.D. Copper Tube		
Room heater return line to main	¼" O.D. Copper Tube		
Thermostat Range	40° to 90°		

See catalog in Sweet's Architectural and Light Construction Files

IRON FIREMAN®
Engineered HEATING AND COOLING

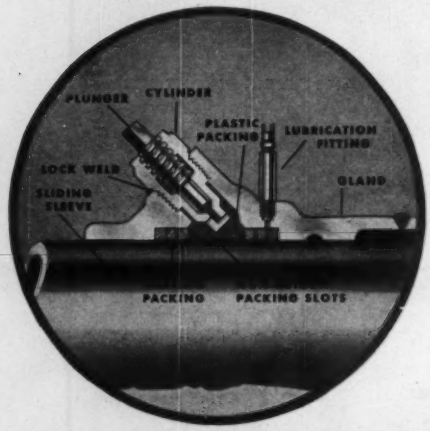
IRON FIREMAN MANUFACTURING COMPANY
3081 West 106th Street, Cleveland 11, Ohio
(In Canada write 80 Ward Street, Toronto)

☐ Send SelecTemp specifications and full information.
☐ Arrange for brief demonstration of SelecTemp room unit, in actual operation, in our office.

Name.....
Firm.....
Address.....
City.....Zone.....State.....

new savings
for expansion joint users

Cross-section of Gun-Pakt feature. To add packing, just add a plug and turn the plunger. Note non-return packing slots at bottom of cylinder.



The Yarway Type W Gun-Pakt Expansion Joint has an improved one-piece design of body and gland and improved method of packing that provide new maintenance economies and greater operating efficiency.

Bolted joint between body and gland is eliminated; the steel body includes gland and guide. Shorter face-to-face dimensions are possible. Improved angle of packing guns makes them more accessible and *permits injection of the special plastic packing directly into packing space.*

The famous Yarway *Gun-Pakt* feature permits *addition of packing under full steam pressure. No need for costly shutdowns to repack.*

Sizes 1½" to 30", pressures 150, 300, 400 psi. Single or double types, flanged or welding ends.

For full description, write for new Yarway Bulletin EJ-1916.

20" Yarway Type W Gun-Pakt Joint with base, single type, welding ends, 8 guns.

YARNALL-WARING COMPANY
107 Mermaid Avenue
Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES

YARWAY GUN-PAKT

...a good way to specify expansion joints

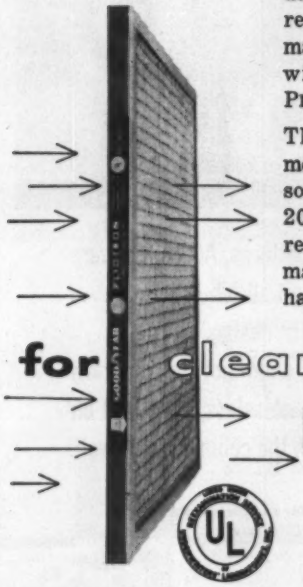
The **money they saved** can mean **money in your pocket!**

EXCESSIVE soilage of merchandise—especially in the white-goods department—was costing this big New York department store plenty. So they were ready to listen when the local PLIOTRON man suggested replacing all 300 filters with his super-filters—even though PLIOTRON costs more initially.

They soon found it was "protection money" well spent. For the profit-eating soilage of their white goods was cut by 20%. What's more, the super-filters remained effective far longer. And the man who installed them had a healthier, happier account.

That one led to others, too. For stores, plants and homes alike are always in the market for filters that provide cleaner air at lower cost. And PLIOTRON super-filters capture up to 5 times as many of those fine, hardest-to-catch dirt particles as ordinary types. Depth-loaders—not just surface-loaders—they outlast the others. Even when dirty, a simple bath restores full filter-power.

Here, then, is a filter that will build your reputation—and business—with every installation. One job leads to another—and another. For the full PLIOTRON story, write Goodyear, P.O. Box 288, Akron, Ohio.



for cleaner air everywhere-

PLIOTRON AIR FILTER BY

GOODYEAR

60th GOODYEAR ANNIVERSARY

THE GREATEST NAME IN RUBBER

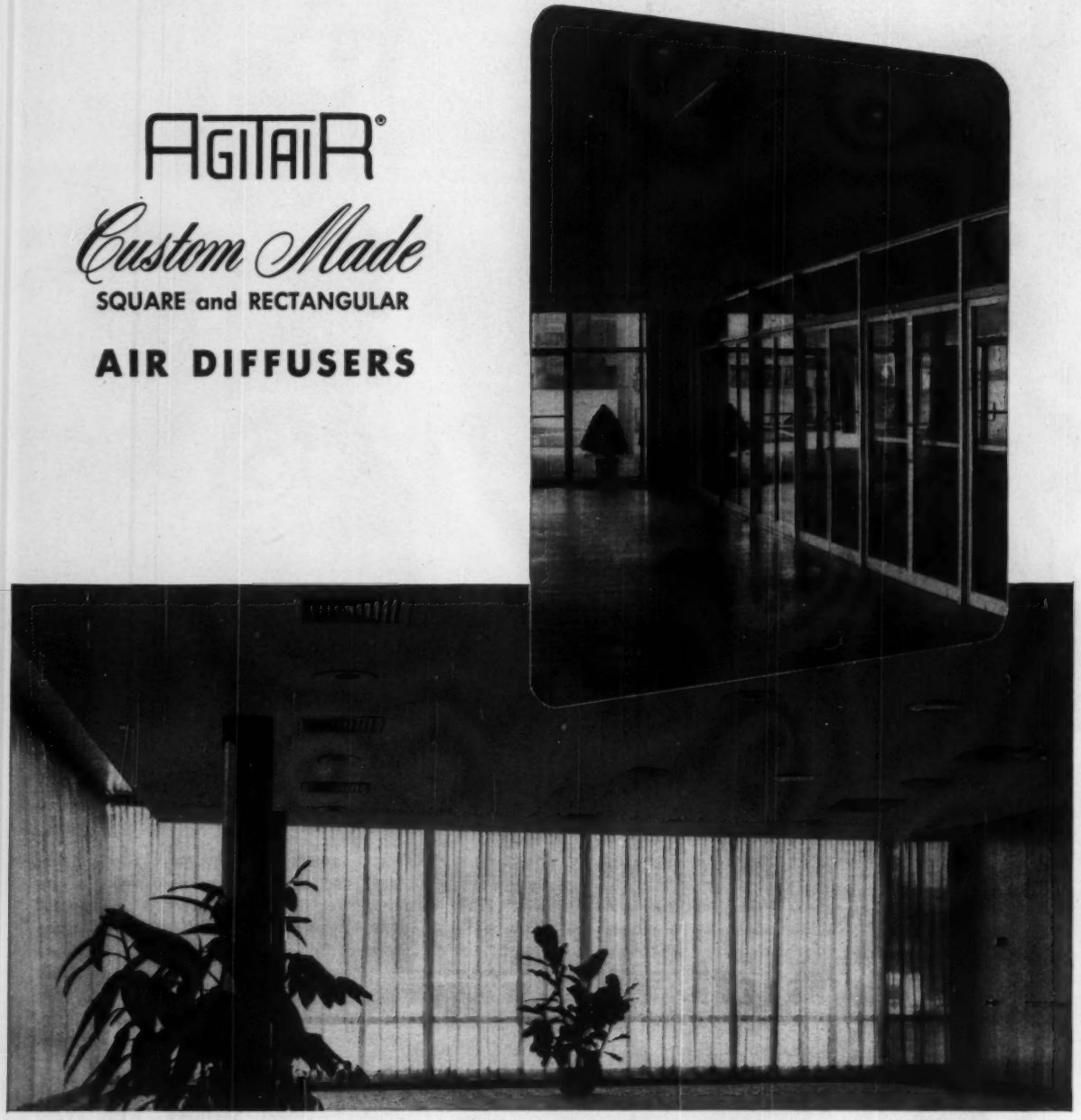
Pliotron—T. M. The Goodyear Tire & Rubber Company, Akron, Ohio

AGITAIR®

Custom Made

SQUARE and RECTANGULAR

AIR DIFFUSERS



Custom made in unlimited air patterns, AGITAIR square and rectangular air diffusers suit all job conditions . . . blend perfectly with any interior design.

These AGITAIR diffusers need not be centrally located. They assure draftless, noiseless, equalized air distribution from any location in the ceiling or side wall.

Write for Catalog R107 for complete data on these Agitair Diffusers

THERMOTANK — AGITAIR®

high velocity units • punkah louvers
air diffusers • filters • exhausters

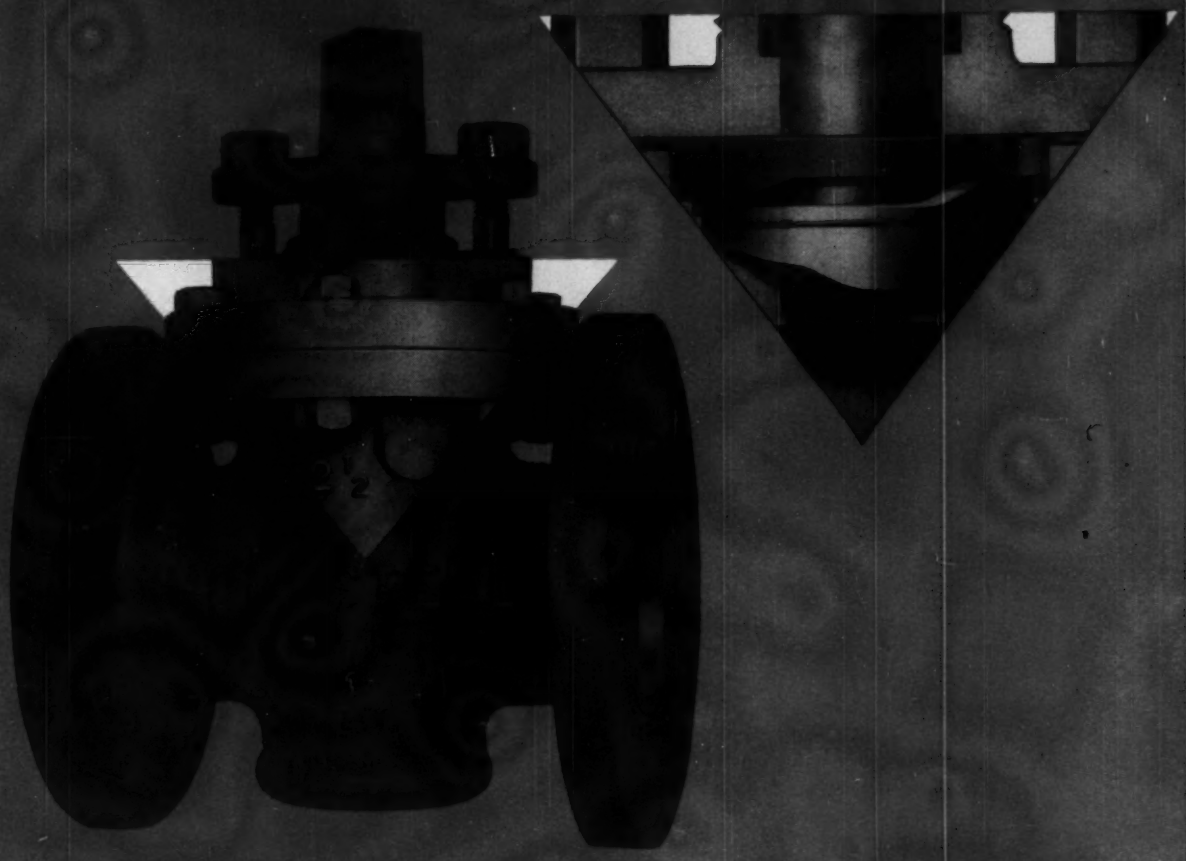
Sold exclusively by representatives for

AIR DEVICES INC.

185 MADISON AVENUE, NEW YORK 16, N. Y.

In the spots that count... Homestead® Valves are

QUICK-ACTING



FASTER FLUID CONTROL is guaranteed by the quarter-turn action that fully opens or closes Homestead Cam-Seald Valves. A cam limits plug travel and automatically presses the matched seating surfaces of the plug and body together to form a leakproof, metal-to-metal seal. Additional design features such as the sealed bottom, seal between cap and body, the deep stuffing box, and the fact that fluid or grit cannot pass across the seating surface in the open or closed position, assure long, leak-free service. Write today for complete information—see how Homestead fills your needs.

h
v

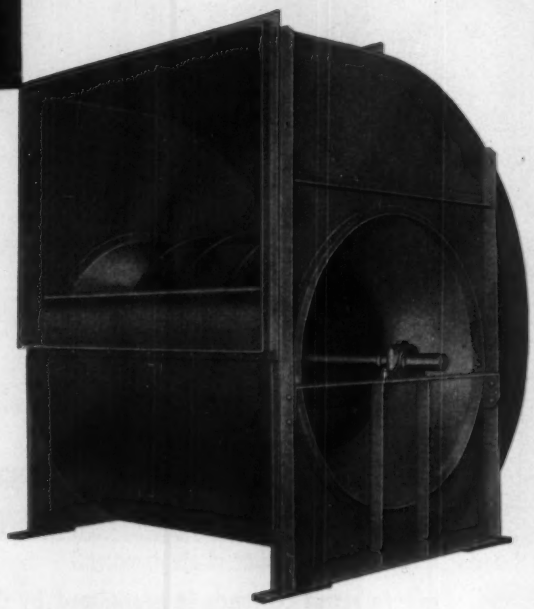
HOMESTEAD VALVE MANUFACTURING COMPANY

P. O. Box 128 ● Coraopolis, Pa.

from California to Massachusetts...

it's a typical installation!

Massachusetts Power Fixed Fans selected for 575 Lexington Avenue (See ad in New York Times, Feb. 23rd issue). Size 100 fan shown below is DIDW, wheel dia. 59-½", 65,875 CFM. This is one of seven return fans handling a total of 387,225 CFM. Also included in installation are eight Massachusetts general exhaust fans.



575 Lexington Avenue.

Sam Minskoff & Sons—
Owners and builders.

Cushman & Wakefield Inc.,
Renting and managing agent.

Sylvan Bien & Robert L. Bien,
Architects.

Sears & Kopf—
John Anselmo Assoc.
Consulting Engineers.

Raisler Corporation
H. V. & A. C. Contractor.

MASSACHUSETTS BLOWER DIVISION

The BISHOP & BABCOCK Mfg. Co.

4901 HAMILTON AVENUE · CLEVELAND 14, OHIO

The MASSACHUSETTS Line

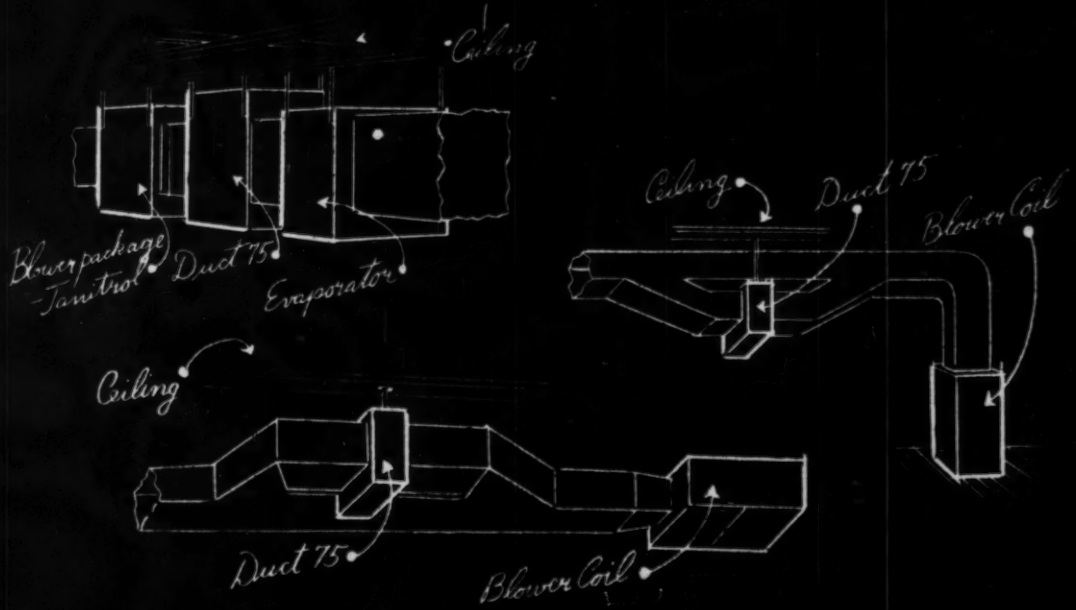
Duct Furnaces — Janitrol

A.I.A. 30-C-43

Versatile—to the Nth degree!

new JANITROL duct 75 furnaces

for commercial—industrial heating and ventilating and specially designed for use in year 'round systems.



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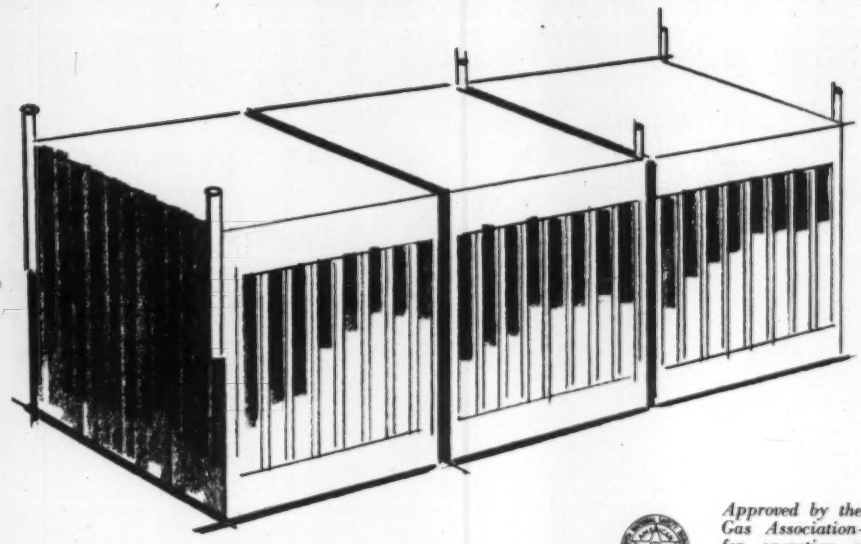


Approved by the American Gas Association—furnished for operation on natural, manufactured, mixed, LP and natural-LP (dual-fuel) gases.

Here now from Janitrol is a really versatile duct furnace . . . the revolutionary new Janitrol Series DUCT 75, bringing you new flexibility in heating system design and installation for all your commercial-industrial jobs.

These compact, easily-installed, "packaged" furnaces are furnished in unit capacities of 200,000 and 300,000 btu/hr. input. You can install them singly, or side-by-side in batteries of two or more to provide inputs from 200,000 to 2,000,000 btu or more in increments of 100,000 btu/hr. input, with individual controls for each unit.

New advanced design of the DUCT 75 provides for draft hood relief at front, and combustion air inlets at both front and back of each unit. Thus a number of units can be bolted together with sides in contact. This results in an assembly so rigid that the two supports at each end of the two-unit assemblies provide adequate support. (See fig. 1.) Pipe hangers designed to serve as connections for overhead suspension are reversible to form floor support legs. The threaded ends used for attaching to overhead supports accommodate pipe leg extensions for floor mounting.

The heat exchanger assembly in Janitrol DUCT furnaces are practically indestructible. The exclusive Multi-Thermex heating element assembly is internally and externally armored with a fire-fused protective coating to assure a tight, non-scaling heat exchanger that is resistant to corrosion and superior to either cast iron or conventional steel. This design has been thoroughly proved in over 1/2 million tubes used in the toughest commercial-industrial applications, over the past 10 years.

All in all, Janitrol's all-new Series DUCT 75 Furnaces provide heating-cooling system design flexibility and installation ease never before possible . . . enable you to "customize" commercial-industrial jobs to individual requirements at lowest possible cost. Get all the facts on these *really versatile* new furnaces from your Janitrol Representative.

JANITROL SERIES DUCT 75

Standard Equipment

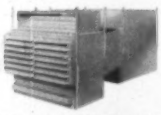
- **Armored Multi-Thermex Heat Exchanger**
- **Ampli-Fire Burners**
- **Draft Hood Field-reversible**
- **Automatic Recycling Pilot**
- **Limit Control**
- **Gas Pressure Regulator**
- **Pilot Shutoff Valve**
- **Main Shutoff Valve**
- **Low Voltage Solenoid Gas Valve with Transformer (230v, 60c)**
- **Casing finished in blue-gray baked enamel**
- **Pipe Hangers—ceiling suspension—field reversible for floor mounting**

The Complete Line of Janitrol Duct Heating Equipment

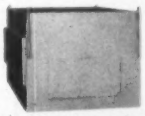
DUCT-75, the all-new Janitrol design described above. Two basic units combined for any job from 200,000 Btu/hr., up to several million.

DUCT-55, individual furnaces in attractive casings. Available in five sizes . . . 100,000; 125,000; 175,000; and 225,000 Btu/hr. inputs.

UNIT HEATERS, Model UCS, propeller-type ceiling-suspended, provide the lowest initial cost automatic heating. In 10 sizes, from 30,000 to 225,000 Btu/hr. inputs.



BCC, Blower Unit Heaters for use independently of central systems. Available with enclosed or exposed blowers with 300,000; 400,000 and 500,000 Btu/hr. inputs.



BLOWER PACKAGES designed for installation with minimum field assembly work. Series 75 has capacity range from 3,000 to 7,000 CFM; Series 135 has range from 6,000 to 13,500 CFM.

Tear out on perforated line and file for future reference

PRESSURE DROP (RESISTANCE) AND TEMPERATURE RISE AT VARIOUS FLOW RATES THROUGH SERIES DUCT-75

SIZE 200

CFM	1330	1500	1600	2000	2250	2400	2800	3000	3200	3400	3600	3800	4000
Resistance Inches Water	.043	.050	.059	.086	.105	.12	.155	.175	.20	.222	.240	.252	.290
Temp. Rise ° F.	112	100	90	75	66	63	53	50	47	45	42	39	37

SIZE 300

CFM	2000	2250	2400	2800	3000	3200	3400	3600	3800	4000	4200	4500	4800	5100	5400	5700	6000
Resistance Inches Water	.043	.050	.059	.076	.086	.096	.11	.12	.13	.145	.155	.175	.20	.222	.240	.252	.290
Temp. Rise ° F.	112	100	90	80	75	70	65	63	59	56	53	50	47	45	42	39	37

Performance Tables

WITH DIFFERENT MOTOR-DRIVE COMBINATIONS

SERIES 75

†Filter Pr. Drop Inches W.C.	*C.f.m. Delivery	○Static Pressure														
		Free Delivery	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.4
.040	3000						**A-½**	**A-½**	**A-½**	**A-½**	**A-¾**	**A-¾**	**A-¾**	C-1	C-1	C-1
.05	3500						**A-½**	A-¾	A-¾	A-¾	D-1	D-1	C-1	C-1	C-1	C-1½
.07	4000					**A-¾**	**A-¾**	D-1	D-1	D-1	D-1	C-1	C-1½	C-1½	C-1½	C-1½
.08	4500				D-1	D-1	D-1	D-1	D-1½	D-1½	C-1½	C-1½	C-1½	C-1½	C-1½	C-2
.10	5000			D-1	D-1	D-1½	D-1½	D-1½	D-1½	C-1½	C-1½	C-1½	C-2	C-2	C-2	C-2
.13	5500		D-1½	D-1½	D-1½	D-1½	D-1½	D-1½	C-2	C-2	C-2	C-2	E-3	E-3	E-3	E-3
.15	6000	D-1½	D-1½	D-2	D-2	D-2	D-2	C-2	E-3	E-3	E-3	E-3	E-3	E-3	E-3	E-3
.18	6500	D-2	D-2	D-2	F-3	E-3	E-3	E-3	E-3	E-3	E-3	E-3	E-3	E-3		
.20	7000	F-3	F-3	F-3	E-3	E-3	E-3	E-3								
.23	7500	F-3	E-3	E-3												

SERIES 135

†Filter Pr. Drop Inches W.C.	*C.f.m. Delivery	○Static Pressure															
		Free Delivery	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5
.06	6000						**A-¾**	**A-¾**	**A-¾**	**A-¾**	D-1	C-1	C-1	C-1½	C-1½	C-1½	C-1½
.07	6500						**A-¾**	**A-¾**	D-1	D-1	D-1	C-1	C-1½	C-1½	C-1½	C-1½	C-1½
.08	7000					**A-¾**	**A-¾**	D-1	D-1	D-1	D-1	C-1½	C-1½	C-1½	C-1½	C-2	C-2
.10	7500					D-1	D-1	D-1	D-1	D-1½	C-1½	C-1½	C-1½	C-1½	C-2	C-2	C-2
.11	8000				D-1	D-1	D-1	D-1½	D-1½	D-1½	C-1½	C-1½	C-2	C-2	C-2	C-2	C-2
.13	8500			D-1	D-1	D-1½	D-1½	D-1½	D-1½	C-1½	C-2	C-2	C-2	C-2	C-2	E-3	E-3
.14	9000			D-1	D-1½	D-1½	D-1½	D-1½	D-1½	C-2	C-2	C-2	C-2	C-2	E-3	E-3	E-3
.16	9500		D-1½	D-1½	D-1½	D-1½	D-1½	D-2	C-2	C-2	C-2	C-2	E-3	E-3	E-3	E-3	E-3
.17	10000	D-1½	D-1½	D-1½	D-1½	D-1½	D-2	C-2	C-2	C-2	E-3	E-3	E-3	E-3	E-3	E-3	
.19	10500	D-1½	D-1½	D-1½	D-2	D-2	D-2	C-2	E-3	E-3	E-3	E-3	E-3	E-3	E-3		
.20	11000	D-1½	D-2	D-2	D-2	D-2	C-2	E-3	E-3	E-3	E-3	E-3	E-3				
.23	11500	D-2	D-2	D-2	D-2	E-3	E-3	E-3	E-3	E-3	E-3						
.24	12000	D-2	D-2	E-3	E-3	E-3	E-3	E-3	E-3								
.27	12500	F-3	E-3	E-3	E-3	E-3	E-3										
.28	13000	E-3	E-3	E-3	E-3												
.30	13500	E-3	E-3														

Bold type indicates standard motor and drive.

† Pressure drop through filters based on clean filters.

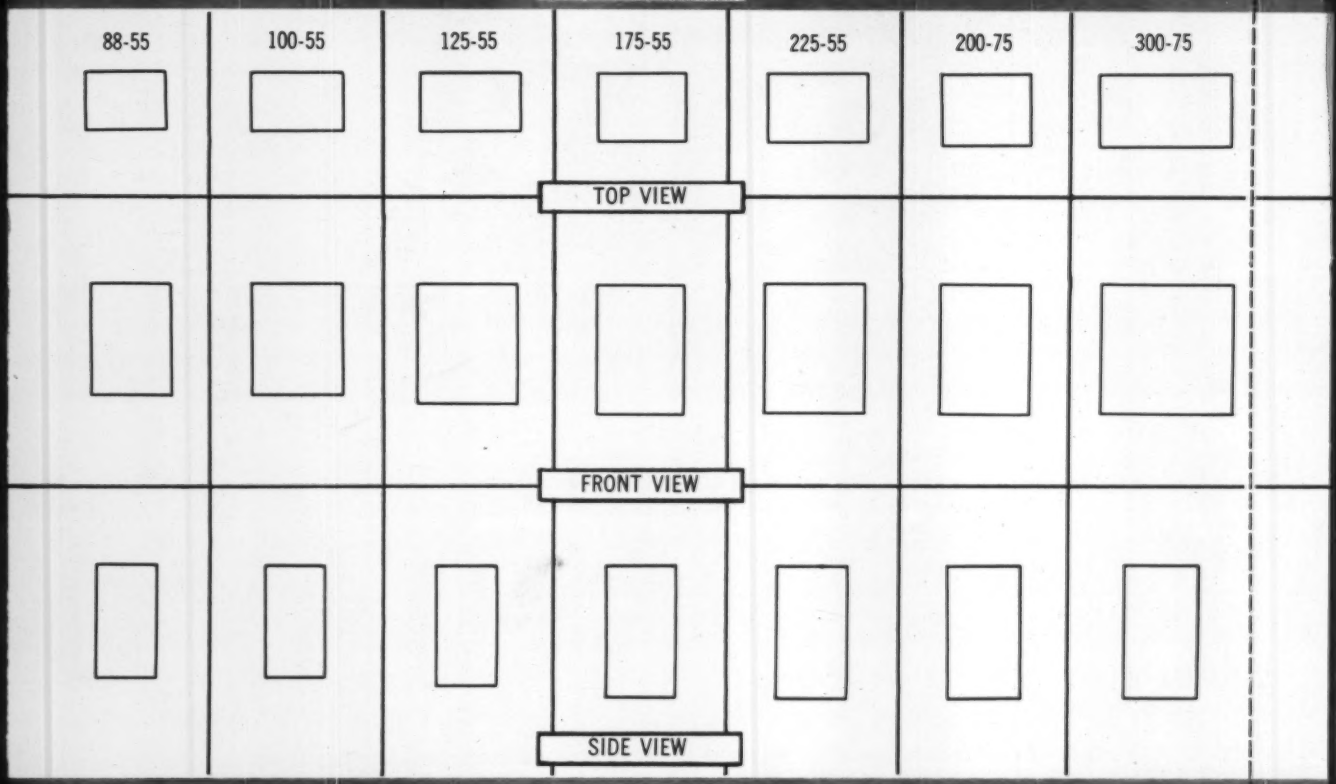
* Standard Air.

○ Static pressure of a system is the summation of all resistances including that of the duct system, heater, coils, etc.

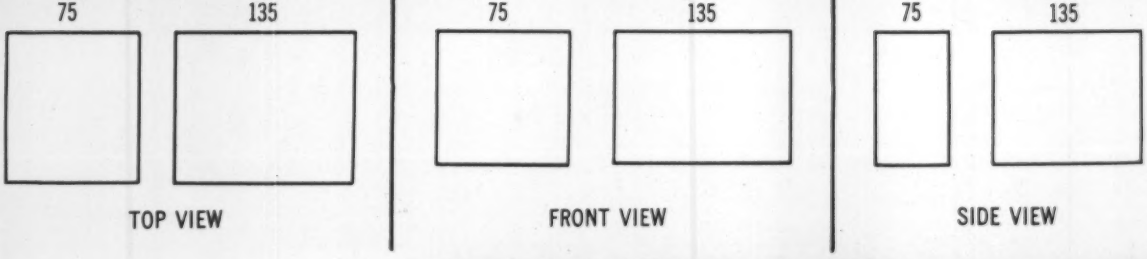
FOR YOUR CONVENIENCE, SCALE TEMPLATES ARE PRINTED ON THE LAST PAGE

Templates 1/4" Scale

DUCT FURNACES



BLOWER PACKAGES



JANITROL

HEATING & AIR CONDITIONING DIVISION
Surface Combustion Corporation, Columbus 16, Ohio
In Canada: Moffats Ltd., Toronto

"Bethcon looks good, and does a nice job"

That's what one of our new customers volunteered about Bethcon a few weeks ago. He's no metallurgist, so he couldn't elaborate very much on his statement. But here is the probable reason for his enthusiasm:

Bethcon is galvanized in Bethlehem's up-to-the-minute continuous lines at Sparrows Point, Maryland, which include a continuous annealing process. This treatment gives the steel a very desirable combination of ductility and stiffness, which makes for easy workability and a strong, rigid sheet-metal product.

Bethlehem's continuous galvanizing process also causes the zinc to adhere to the steel much more tightly than the conventional method. You can put a Bethcon sheet through the toughest forming operations—even double it back on itself—without cracking or flaking the coating. The coating itself is more uniform, too, with a uniform thickness across the sheet and no bead on the end.

Bethcon is available in gages 13 and up, in either plain open hearth or copper-bearing steel. A Bethlehem representative will be glad to discuss your sheet metal problems with you. Just call or write to the Bethlehem district office nearest you.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation
Export Distributor: Bethlehem Steel Export Corporation

BETHLEHEM STEEL

BETHLEHEM STEEL

At This Kresge Store . . .

Westinghouse Life-Line A motors have

JOB TESTED

This busy self-service Kresge store, located in Ross Township, Pennsylvania, relies on Westinghouse Life-Line "A" motor-powered central air-conditioning to keep customers cool and comfortable while the temperature climbs outside.

proved outstanding for air conditioning

Westinghouse motors have been thoroughly tested in tough air-conditioning jobs like this . . . and have proven outstanding for quiet, long-term, dependable performance.

The Life-Line "A"® is built for rugged duty, with an armorized frame to assure proper alignment and protect against physical abuse. Ventilation openings in end brackets make the Westinghouse Life-Line "A" motor completely drip-proof, regardless of mounting position. 4-way sealed, prelubricated bearings keep grease in . . . dirt and water out . . . eliminates on-the-job greasing in out-of-the-way applications.

Tests in soundproof laboratories have proven that Life-Line "A" motors, through precision manufacture and dynamic balancing, are producing an operating sound level lower than any other standard motor.

FOR COMPLETE INFORMATION, on these Westinghouse air-conditioning motors, call your Westinghouse sales engineer or distributor. Or, write Westinghouse Electric Corporation, P.O. Box 868, 3 Gateway Center, Pittsburgh 30, Pennsylvania. J-22057

YOU CAN BE SURE...IF IT'S Westinghouse

Potosi school gets the finest in fresh

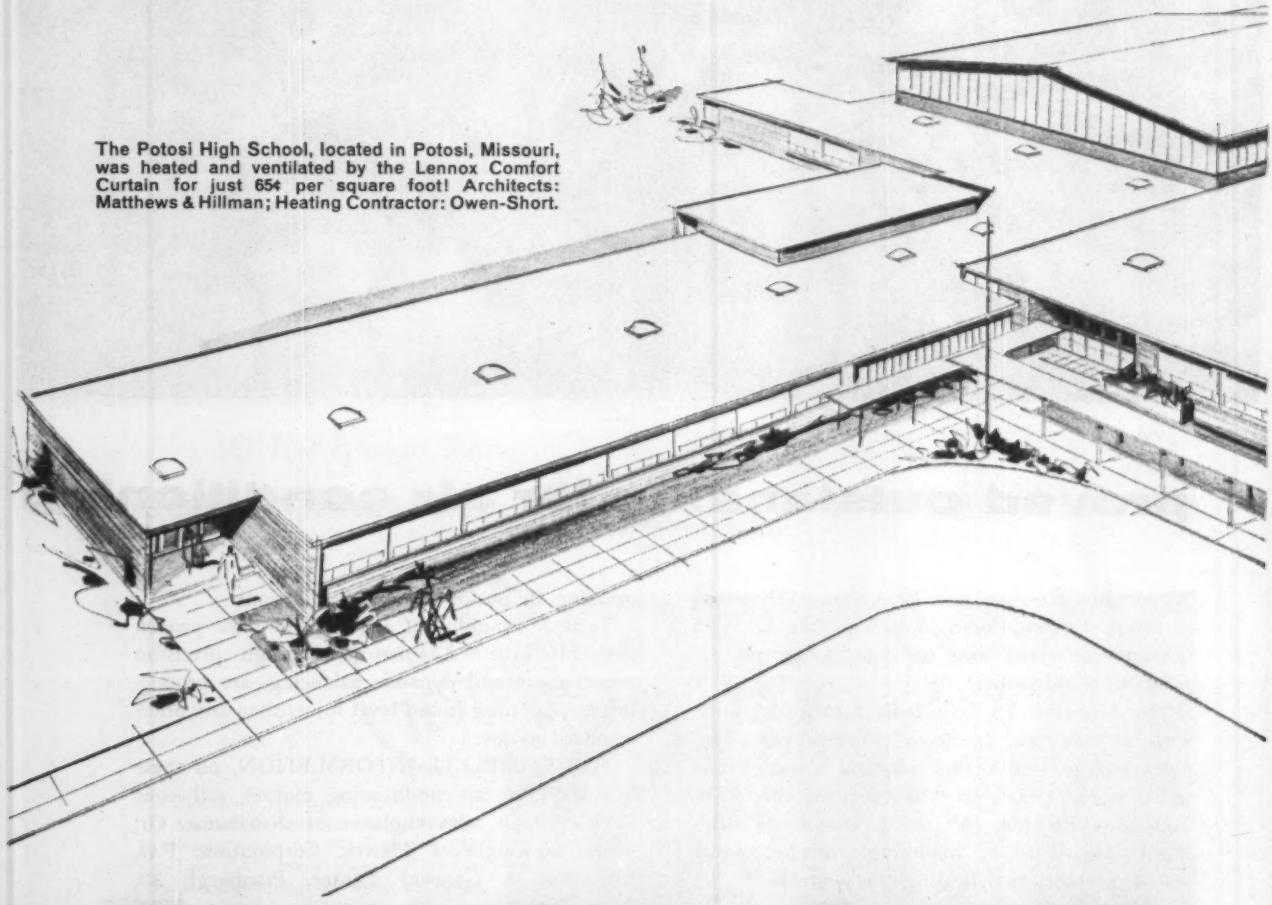
installed complete with automatic

New Lennox Comfort Curtain System automatically draws in fresh air from outside . . . warms, cleans and circulates air quietly and evenly throughout the classroom!

Hard to believe, isn't it?—that after all these years a new and better fresh air heating and ventilating system can be installed *for a fraction of the cost* of systems used previously. Yet it's true! 65¢ per square foot was the *complete* cost of the Lennox Comfort Curtain System in the Potosi, Missouri High School. Including fully automatic controls, ductwork, labor—everything!

Of course, 65¢ per square foot is unusually low, even for the Comfort Curtain. But costs of $1.03 in Indiana, $1.15 in Montana, and $1.12 in South Dakota are *usual and typical* of the amazing savings offered by the Lennox Comfort Curtain.

How is this possible? The Lennox Comfort Curtain System applies to schools the sound, tested principles of warm air heating. It eliminates expensive pipes, boilers and chimneys. Moreover, it saves hundreds of dollars per classroom per year *every* year it is in use. Fuel is consumed only when heat is required, maintenance is amazingly simple and low-cost. Yet—and this is important—the Lennox Comfort Curtain System



The Potosi High School, located in Potosi, Missouri, was heated and ventilated by the Lennox Comfort Curtain for just 65¢ per square foot! Architects: Matthews & Hillman; Heating Contractor: Owen-Short.

LENNOX COM

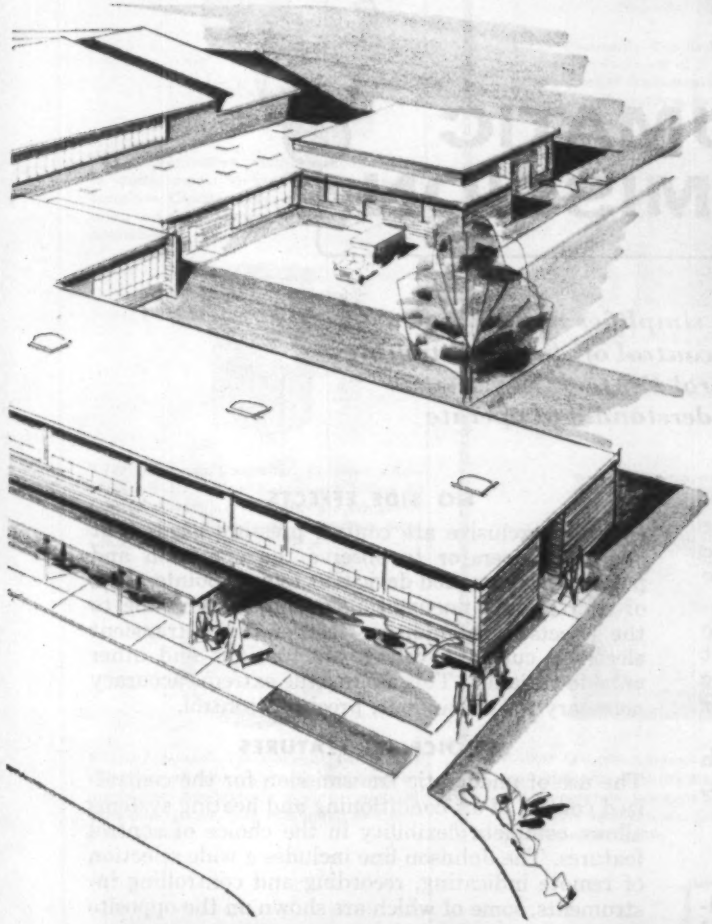
air heating and ventilating —

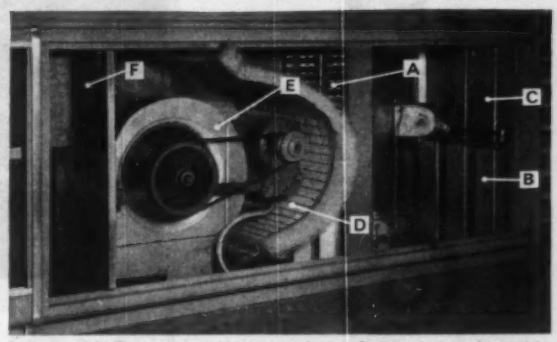
controls — for just 65¢ per square foot!

does a far better job than costlier systems used previously for school heating and ventilating.

It provides a full, even flow of air throughout the entire length of the exposed classroom wall. It is amazingly quiet. And it holds room temperatures to a variance of six-tenths of one degree, circulates air continuously for perfect distribution, introduces a continuous supply of fresh air into the daytime heating cycle, and provides *tons* of needed fresh air cooling without the cost of refrigeration!

Get full information on this new low-cost system of classroom heating and ventilating. Send coupon below for free booklet, today!





Lennox Air Processing Unit introduces fresh air in adjustable volumes (A); transmits warm air (B) from adjacent or remote heating unit; continuously recirculates indoor air (C); filters air clean (D). Lennox' exclusive floating blower (E) and acoustical lining (F) assure a degree of quietness never before achieved.

A comfort curtain of healthful air rises from bookshelf duct along the full length of the exposed classroom wall in this Des Moines, Iowa school.

LENNOX

©1958 Lennox Industries Inc., Heating and Air Conditioning, founded 1895; Des Moines and Marshalltown, Ia.; Syracuse, N.Y.; Columbus, O.; Decatur, Ga.; Ft. Worth; Los Angeles; Salt Lake City. In Canada: Toronto, Montreal, Calgary, Vancouver, Winnipeg.

Lennox Industries Inc., Dept. HP-82
1701 E. Euclid Ave., Des Moines 5, Iowa

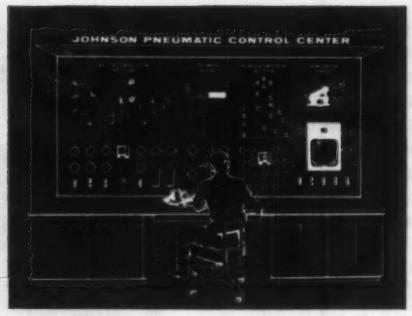
Gentlemen: Please send me your free booklet on the Comfort Curtain System of classroom heating and ventilating.

NAME_____

ADDRESS_____

CITY_____ ZONE____ STATE_____

FORT CURTAIN



PNEUMATIC TRANSMISSION

Pneumatics simplifies and improves centralized control of Air Conditioning— makes Control Centers easier to understand and operate

With pneumatic transmission by Johnson you can give your clients the benefits of control center instrumentation that is as simple and trouble-free as the pneumatic controls used elsewhere in the building!

Thanks to universal familiarity with pneumatic controls, operating personnel easily become expert in the operation of even the largest pneumatic control centers. No highly specialized training or extensive study is required.

Since pneumatic transmission functions with both fewer and simpler components, there are no complex, costly upkeep problems.

CONTINUOUS INDICATION

Pneumatic transmission offers other exclusive advantages that add greatly to ease of operation and efficiency of centralized control.

For example, only the pneumatic control center gives the operator continuous indication of key temperatures. With a separate pneumatic thermometer for each key point, he can check the entire system with a single glance. There are no buttons to push, no waiting for periodic logging, no codes to check.

NO SIDE EFFECTS

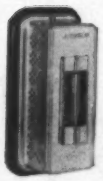
Likewise exclusive are control pressure gages that allow the operator to observe the operation and position of controlled devices at remote points. And, of course, only pneumatic systems are immune to the effects of humidities, temperatures, transient electrical currents, voltage fluctuations and other outside variables. This assures the extreme accuracy necessary for continuous, precision control.

CHOICE OF FEATURES

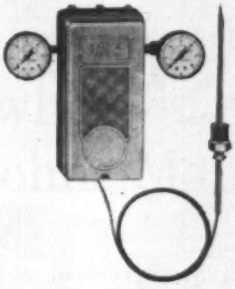
The use of pneumatic transmission for the centralized control of air conditioning and heating systems allows complete flexibility in the choice of control features. The Johnson line includes a wide selection of remote indicating, recording and controlling instruments, some of which are shown on the opposite page.

Pneumatic transmission as applied by Johnson offers you the same exclusive combination of accuracy, simplicity and superior performance that have long made pneumatic temperature control systems the standard everywhere. A nearby Johnson engineer will gladly give you more facts about these and other advantages of pneumatic control centers.

Johnson offers you Control Center instrumentation to meet the exact requirements of the individual installation



T-1210 Room Transmitter. Transmits space temperature to Control Center. Has highly sensitive, low-mass bi-metal measuring element. Temperature range is 50 F.



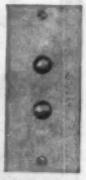
T-1220 Transmitter. Measures temperature in ducts, pipes, tanks, and other remote locations. Compensated, liquid filled measuring element. Ranges of 100 and 200 F available.

T-1270 Receiver Controller. Receives measurements from transmitter and either (1) controls directly, (2) resets remote submaster controllers or (3) acts as a remotely reset submaster to control as in (1) or (2).

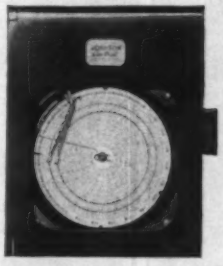
T-1250 Pneumatic Thermometer. For remote indication of temperature as measured by transmitter. Available in a wide variety of sizes and ranges, with Fahrenheit or Centigrade scales.

G-201 Control Pressure Gage. Provides continuous remote indication of the operation of the controllers and position of controlled devices. An invaluable aid to operation.

S-222 Pneumatic Gradual Switch. Permits manual readjustment of the set point of remotely located instruments from the Control Center. Small, highly accurate, trouble-free.



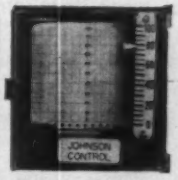
Pneumatic Push-Button Switch. May be used to start and stop fans, pumps and other electrical devices or to position any control device or equipment requiring two-position manual switching.



T-1000 Recorder-Controller. Furnished with powerful, high-accuracy measuring elements for temperature, pressure or relative humidity control applications. One-pen and two-pen models available.

Target Gage. Used in conjuction with Pneumatic Push-Button Switches to indicate operation of electrical equipment. Equipped with high visibility red or green fluorescent segments.

Miniature Indicating Controller. Conserves space on panels without sacrificing quality of control. A wide variety of easy to read scales and charts are available.



Miniature Recorder-Controller. Plug-in type, completely interchangeable with Miniature Indicating Controllers. For temperature or pressure control applications.

T-1050 Indicating Controller. For temperature, pressure or relative humidity applications not requiring a chart record. Master and submaster models available.

JOHNSON CONTROL

PNEUMATIC SYSTEMS

DESIGN • MANUFACTURE • INSTALLATION • SINCE 1885

JOHNSON SERVICE COMPANY
Milwaukee 1, Wisconsin

Please send Johnson Control Center Booklet S-103

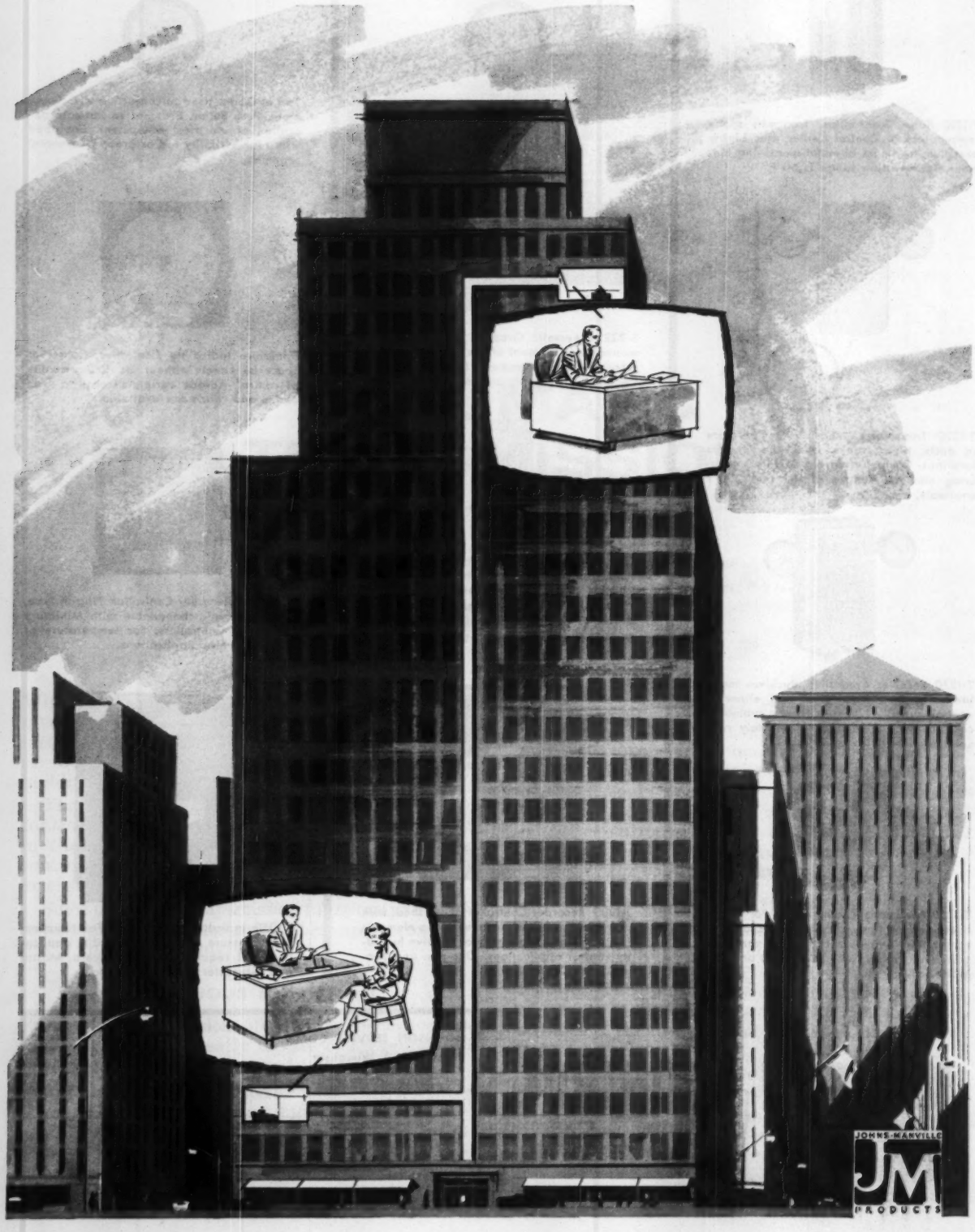
Name & Title_____

Firm_____

Address_____

City & State_____

Mr. Smith is 600 duct feet farther from



the fan room than Mr. Jones, yet . . .

both men work comfortably at the same temperature!

when ducts are *fitted square and tight* with Johns-Manville semi-rigid Spintex Insulation

SEMI-RIGID SPINTEX® works two ways to lessen heat loss, stop condensation: first, with low conductivity . . . then, with its square, tight fit. The structural strength of this material, which is fastened snugly to duct surfaces with pins and clips, prevents "ballooning" due to duct leakage. And butted or mitred joints eliminate stretching and thinning of the insulation at corners. Instead, there's a full thickness of Spintex—with full protection against heat loss and condensation—over the *entire duct area.*

This two-way "edge" in insulating effectiveness is the big reason why leading engineers everywhere specify semi-rigid Spintex . . . for factories, institutions and office buildings of every description.

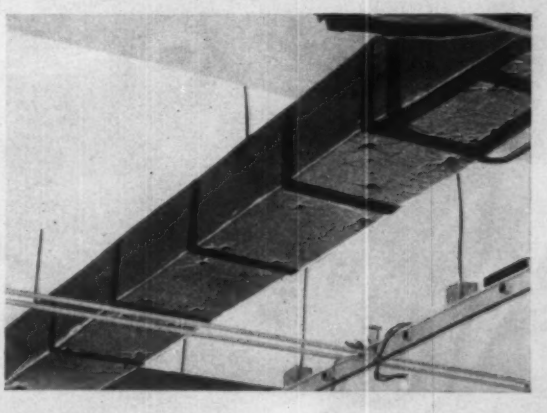
LESS HEAT LOSS...NO CONDENSATION AT CORNERS!
Semi-rigid (not flexible) Spintex fits squarely and tightly all duct surfaces. Stretching and thinning at corners, unavoidable with wrap-around insulations, are eliminated completely. Instead, Spintex retains full thickness everywhere to stop heat loss and condensation. Its structural strength prevents "ballooning."

FACED FOR ANY SPECIALIZED NEED!
J-M offers you a facing to meet any vapor condition, incombustibility requirement or decorative need. Provides good base for plaster finish . . . or where no facing is indicated, Spintex presents an attractive appearance with trim, tidy joints.

INSTALLS QUICKLY . . . ECONOMICALLY.
Spintex is clean, sanitary and "friendly" to handle. It cuts readily with an ordinary knife. Installs quickly, easily, even when ducts are curved or in difficult-to-reach areas.

Produced by a new Johns-Manville spinning process, today's Spintex offers more insulating value than ever. Its mineral fibers are smaller in diameter, and substantially more uniform. This improved fibrous structure adds countless heat-blocking dead-air spaces per cubic inch to help keep working temperatures precisely the same throughout the structure . . . with minimum operating costs!

Your Johns-Manville sales representative will be pleased to send you information, along with samples of Spintex and J-M facing materials. Why not call him today. Or write Johns-Manville, Box 14, New York 16, N. Y. In Canada, 565 Lakeshore Road East, Port Credit, Ontario.



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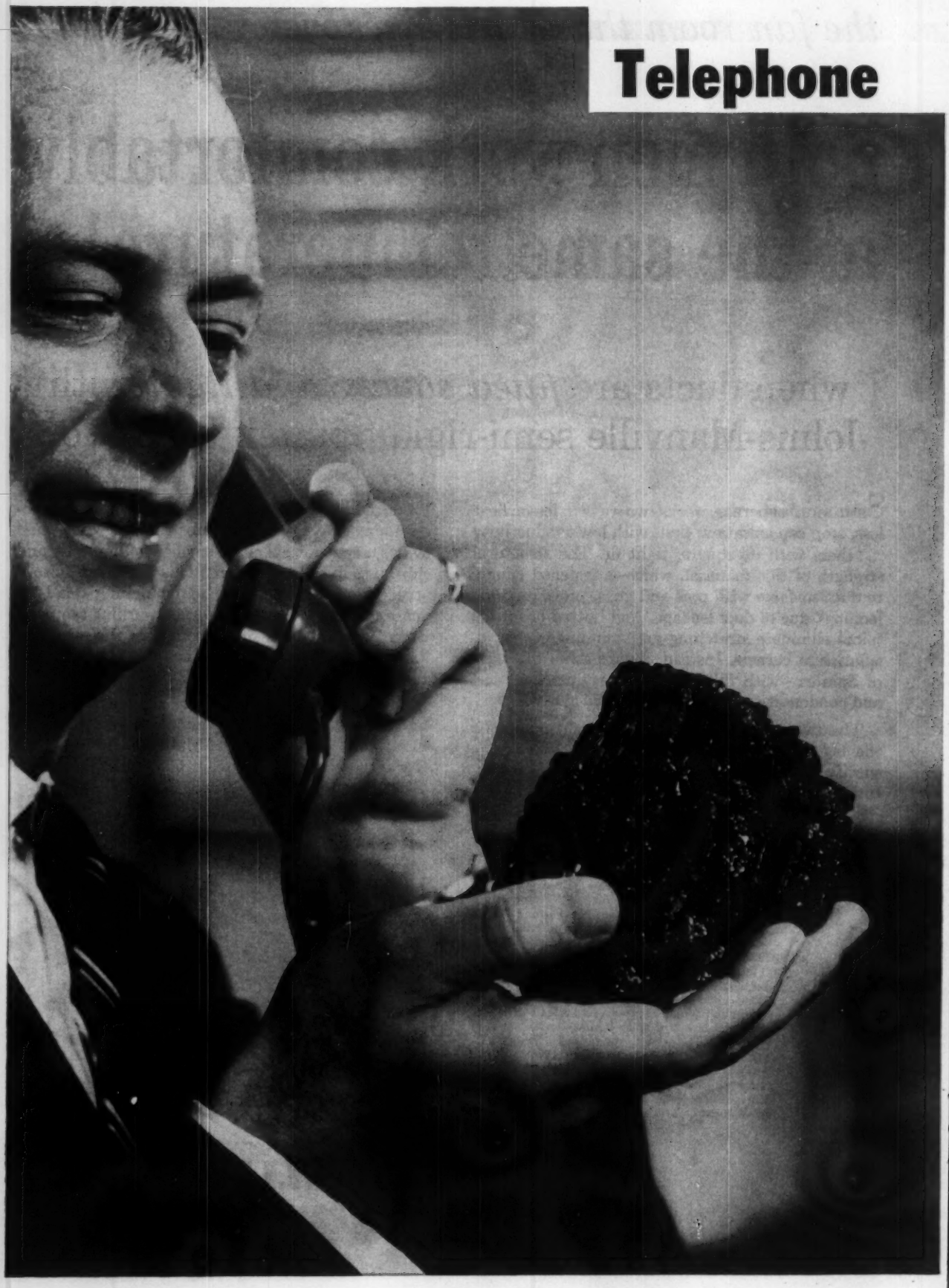
JOHNS-MANVILLE


Telephone

manufacturer calls for coal

Automatic Electric Co. burns coal in new plant because of cost and availability

Modern facilities, modern products, modern fuel—you'll find all three at the new Northlake, Ill., plant of Automatic Electric Co., manufacturing subsidiary of General Telephone. The power house of this communications equipment plant (designed and built by The Austin Company of Cleveland) is as modern and efficient as the manufacturing process itself. The plant required large quantities of economically and reliably produced steam for process work and heating. The fuel selected was *coal*, because of coal's economy and abundant supply. As a result, today Automatic Electric enjoys dependable, low-cost steam.

Facts you should know about coal

You'll find that bituminous coal is not only the lowest-cost fuel in most industrial areas, as in the case of Automatic Electric, but up-to-date coal burning equipment can give you 15% to 50% more steam per dollar. Today's automatic equipment can pare labor costs and eliminate smoke problems. And vast coal reserves plus mechanized production methods mean a constantly plentiful supply of coal at stable prices.

Technical advisory service

To help you with industrial fuel problems, the Bituminous Coal Institute offers a free technical advisory service. We welcome the opportunity to work with you, your consulting engineers and architects. If you are concerned with steam costs, write to the address below. Or send the coupon below for case histories, complete with data sheets. You'll find them informative.

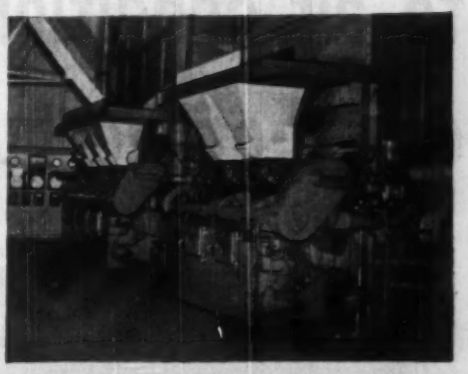
Consult an engineering firm

If you are remodeling or building new heating or power facilities, it will pay you to consult a qualified engineering firm. Such concerns—familiar with the latest in fuel costs and equipment—can effect great savings for you in efficiency and fuel economy over the years.

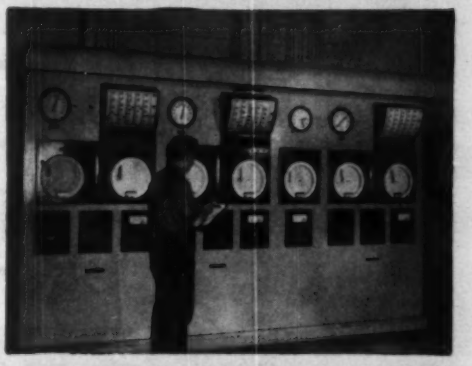
BITUMINOUS COAL INSTITUTE

Department HP-04

Southern Building • Washington 5, D.C.



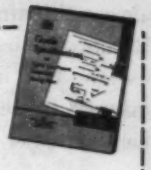
Shown are two of the three Keeler boilers – fired by Detroit Spreader Stokers – in the power plant. At the right is the 22,000 lb/hr boiler. In the background is one of the 50,000 lb/hr boilers. The two sizes allow flexibility in operation for widely varying load requirements.



Control panel by Hays Corporation. This system regulates all operations of the boilers—steam pressure, draft, flue gas temperature, banking periods, etc. —to give complete, automatic control of steam generating operation.

Ash disposal system, by United Conveyor Co., in basement of boiler room. Ash is removed from furnace by Detroit CC grate, drops into hoppers in basement and is taken by vacuum to silo.

The Bituminous Coal Institute now has available a free booklet adaptable for design loads 3,000 to 24,000 EDR steam. This booklet, "Guide Specifications for Typical Low-Pressure Commercial Heating Plant," contains specifications, drawings and tables on all aspects of a typical heating plant. Send in this coupon for your copy.



☐ Guide Specifications Booklet ☐ Case histories on larger plants.

Name_____

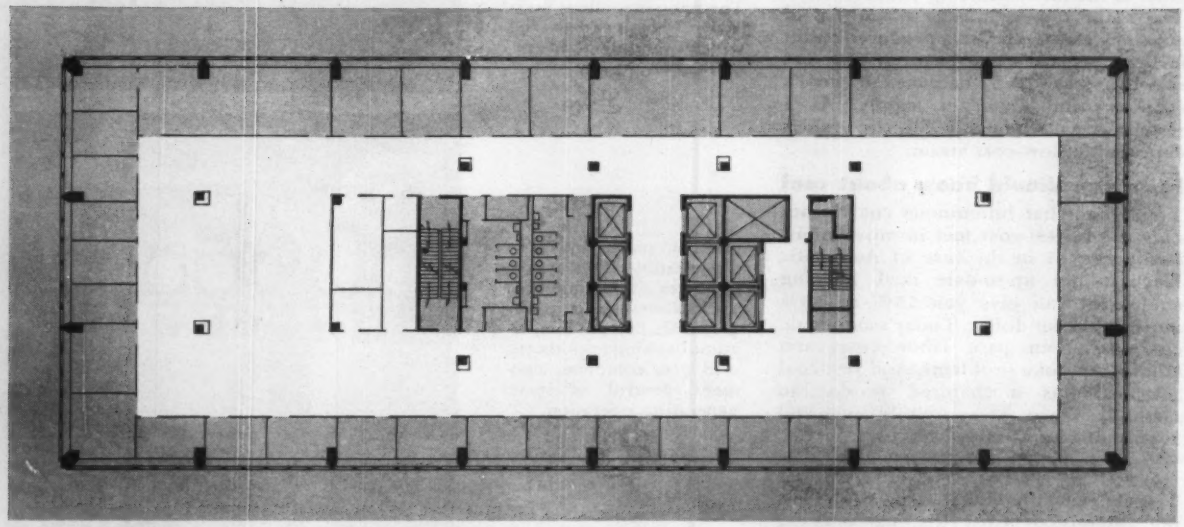
Title_____

Company_____

Address_____

City_____ Zone_____ State_____

Which is the best way to air condition interior areas of an office building?



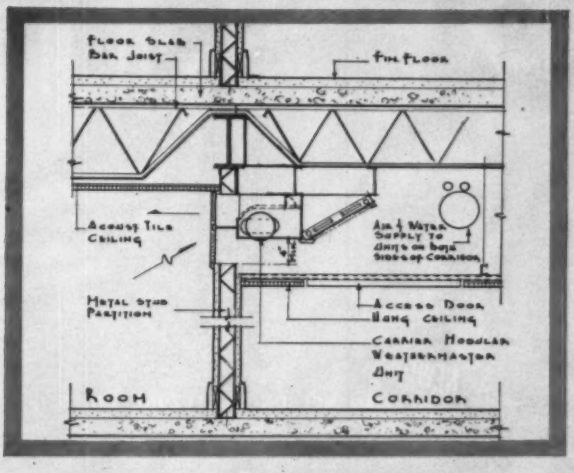
That depends on the amount of heat generated within the interior areas. In most Class A office buildings this heat load is increasing. It is moving up year after year because of the greater use of electronic office equipment and more intense lighting.

This trend should be considered when planning air conditioning both for new and existing buildings. Recent studies prove that it is more economical to use the new air-water Carrier Horizontal Weathermaster* System than any type of all-air system to handle higher heat loads in interior zones. This new Carrier method saves space, costs less to own and less to operate because water is 250 times more effective than air, by volume, in removing heat. In addition, it is capable of handling increasing heat loads as they develop, without costly system changes.

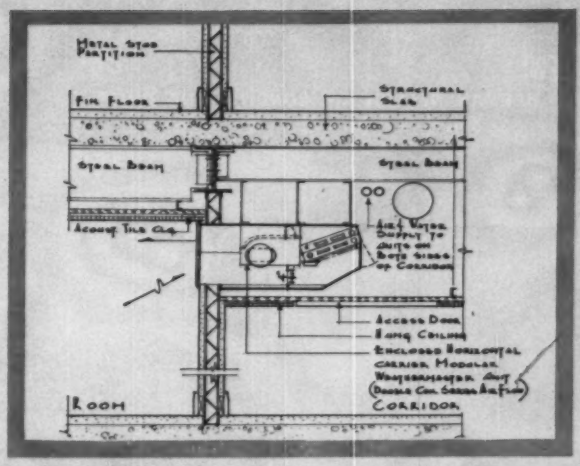
The Horizontal Weathermaster Units adapt readily to any interior situation. On the page at right are six typical arrangements—and there are many more. For complete information, call your nearest Carrier office. Or write Carrier Corporation, Syracuse, New York.

*Reg. U.S. Pat. Off.

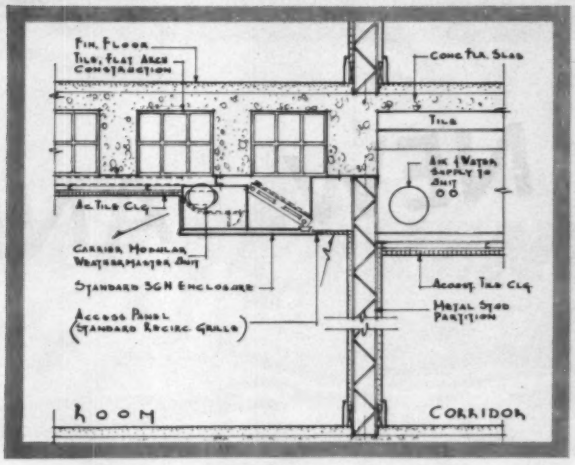
Carrier Air Conditioning · Refrigeration · Industrial Heating



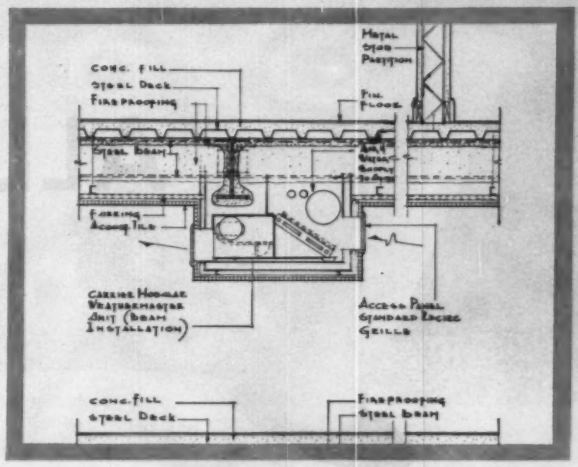
Corridor installation with the unit, supply air conduit and water services concealed above hung ceiling.



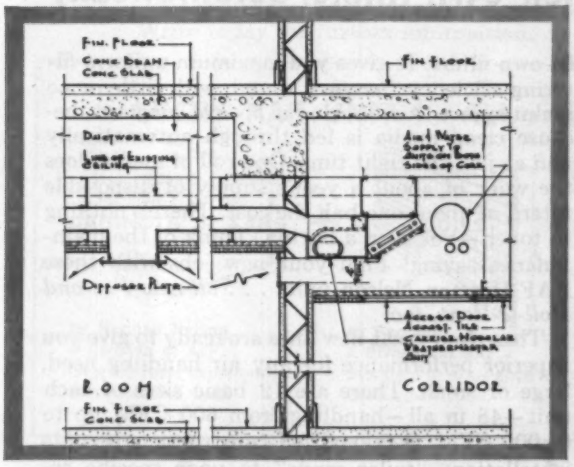
Corridor installation featuring twin coils for extra capacity. Enclosed unit prevents cross circulation.



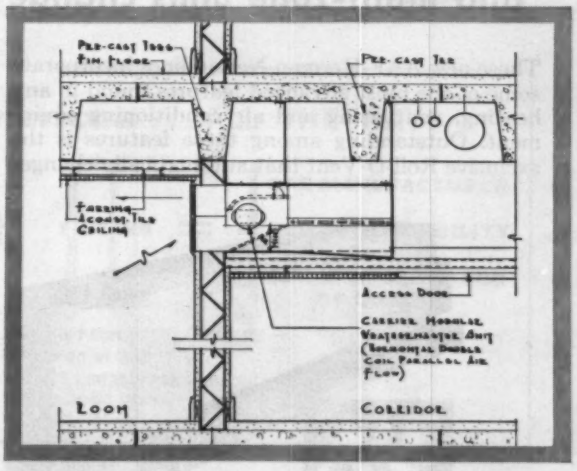
In-the-space installation with standard unit and standard enclosure eliminating need for furring-in.



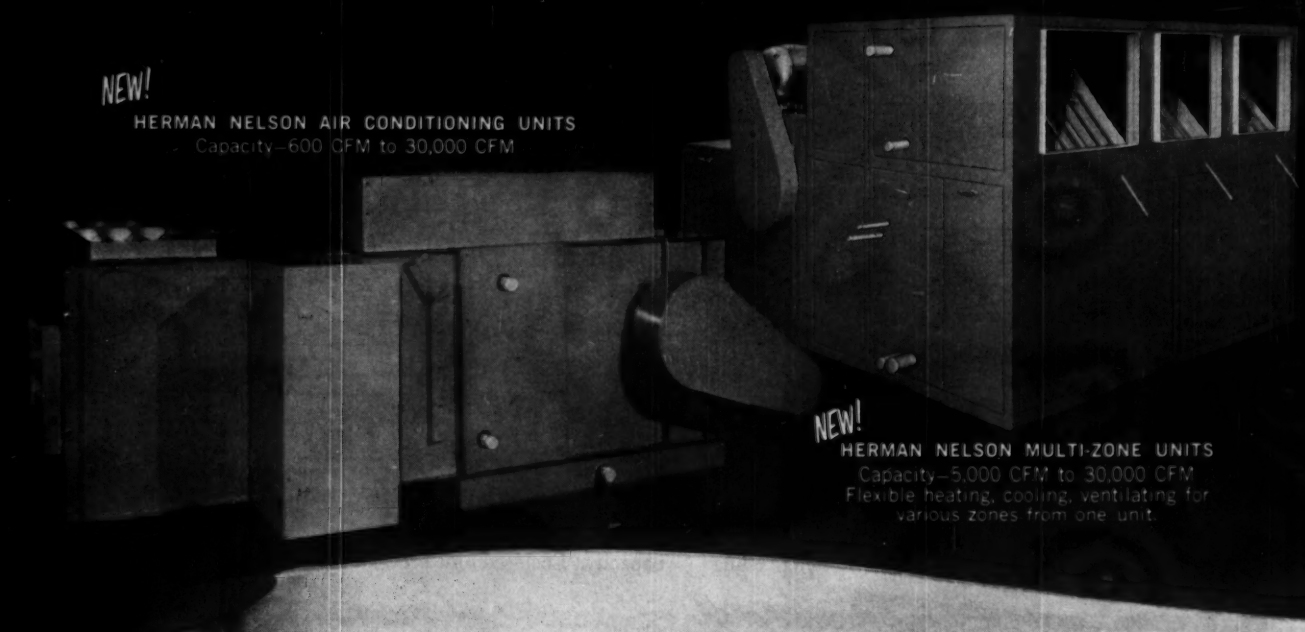
In-the-space installation where structural framing requires unit be tightly fitted against fireproof beam.



Corridor installation using short duct from unit to standard diffuser plate outlet for ceiling distribution.



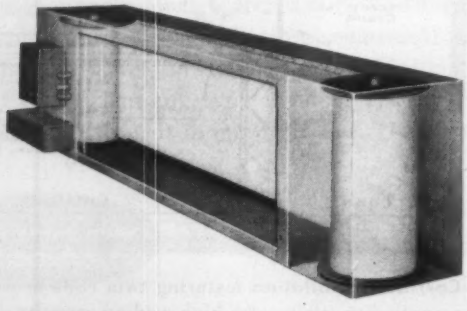
Corridor installation featuring twin coils in parallel mounting to attain extra high cooling capacity.


NEW!
HERMAN NELSON AIR CONDITIONING UNITS
Capacity—600 CFM to 30,000 CFM
NEW!
HERMAN NELSON MULTI-ZONE UNITS
Capacity—5,000 CFM to 30,000 CFM
Flexible heating, cooling, ventilating for various zones from one unit.

ALL NEW...AND

Complete new line of heating, ventilating, air conditioning and multi-zone units change their own filters, automatically

These new AAF-Herman Nelson lines incorporate some of the most advanced features found in any heating, ventilating and air conditioning equipment. Outstanding among these features is the exclusive Roll-O-Vent that automatically changes its own filters. It gives you maximum uniform filtering efficiency the year 'round, with little or no maintenance. Air filtering is always constant, because clean media is fed through automatically and at just the right time. One roll of media does the work of about a year's supply of disposable filters, at about one-half the cost. There's nothing to touch—not even a button. Think of the maintenance saving! Plan your new jobs with these AAF-Herman Nelson units . . . *all new . . . and Roll-O-Vent, too!*



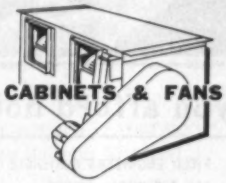
These four great new lines are ready to give you superior performance for any air handling need, large or small. There are 12 basic sizes of each unit—48 in all—handling from 600 CFM up to 65,000 CFM. Sectionalized construction permits installations "tailor made" to your specific requirements.

Better Air is our Business

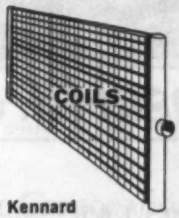
ROLL OVENT TOO

These air handling units are engineered throughout by AAF-Herman Nelson . . . one reliable source to solve all your heating, ventilating and air conditioning problems. Write today for further information.

EVERY AAF UNIT IS ALL American . . . ALL THE WAY!



CABINETS & FANS +



COILS +

FILTERS =

- ONE MANUFACTURER
- ONE RESPONSIBILITY
- ONE HIGH STANDARD OF QUALITY

by Herman Nelson
a Division of AAF
Over 50 years experience in ventilation field.

by Kennard
a Division of AAF
Standard of excellence in coils since 1934.

by Air Filter
Division of AAF
World's largest manufacturer of air filters.

American Air Filter

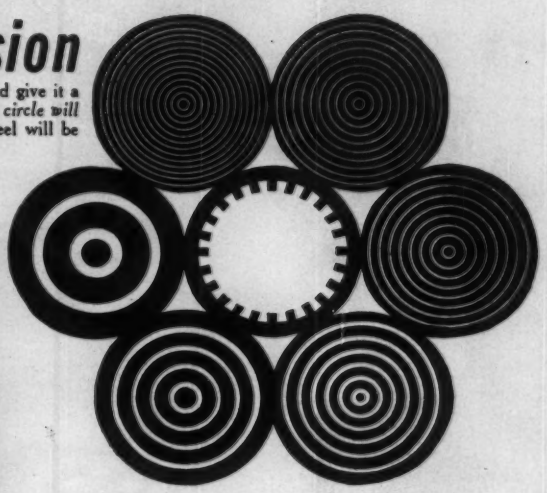
COMPANY, INC. • 373 CENTRAL AVE. • LOUISVILLE, KY.

AAF

herman nelson®

This is an illusion

HOLD this Diagram by the right hand bottom corner and give it a slight but *rapid* circular twisting motion, at which time *each circle will separately revolve on its own axis*. The inner cogged wheel will be seen to revolve in an opposite direction.



THIS *is the real thing!*

insul-fil® the most highly efficient and economical "poured-type-insulation" available for underground steam and hot water distribution systems

The following comparative "K" factors were recorded at the Research and Development laboratories of the Atlantic Refining Company, and are evidence of INSUL-FIL's superiority.

The average "K" factor at 150 p.s.i.g. indicated the following values. These values were computed using 6" of material for the comparative evaluation. The average "K" factor on INSUL-FIL and 100% mined asphalt vary slightly depending on thickness of application.

"K" VALUES:

PERLITE	.39
INSUL-FIL	.451
100% MINED ASPHALT	.74
SOIL	3.12

Installing contractor Rhode Island Covering Co., U. S. Naval Air Station, Quonset Point, R. I., Charles A. Maguire and Associates, Consulting Engineers, Boston, Mass., Providence, R. I.

Installing INSUL-FIL at Idlewild International Airport for Port of New York Authority. (Seelye, Stevenson, Value & Knecht — Consulting Engineers)

COLLEGES and INDUSTRY use *insul-fil*. Can you afford not to?

INSUL-FIL CO., INC. A DIVISION OF
MIRACLE ADHESIVES CORPORATION 250 Pettit Avenue, Bellmore, L. I., N. Y.

Send now for your **FREE** copy of MIRA-DATA SHEET #9, 4 page colorful brochure describing INSUL-FIL.

NAME_____

COMPANY_____

ADDRESS_____

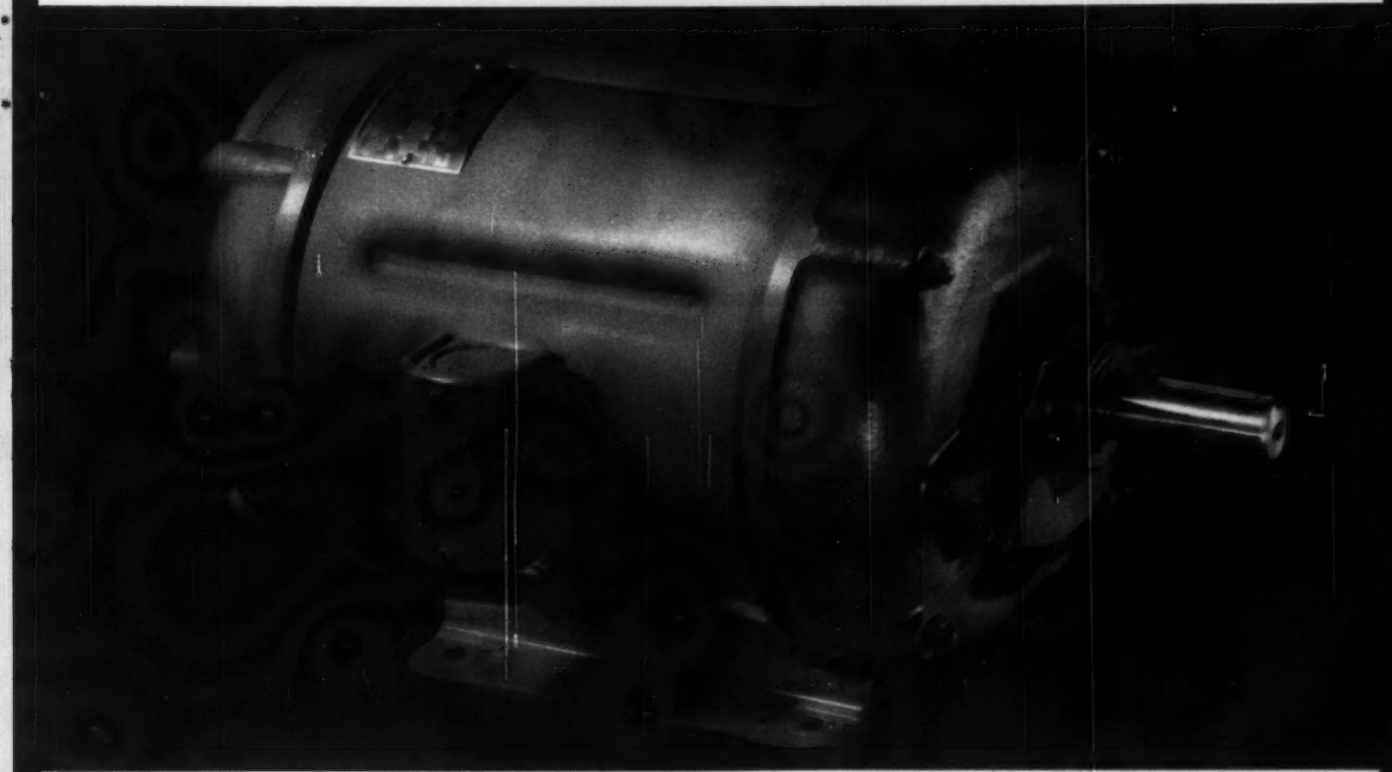
CITY_____ ZONE_____ STATE_____

FIELD ENGINEERS AVAILABLE FOR TECHNICAL ADVICE —

Other Miracle Products for the Insulation Industry:

Zip-on Protektinsul Vinyl Pipe Covering
Zip-on Protekto-Flex, Vinyl Covered Fibrous Glass Insulation
Miracle Surface Anchors
Miracle Insulation Adhesives
Miracle Duct Sealer

Got a Real Tough Starting Problem ?



Single-phase Type RA ½ to 15 hp.

Wagner Repulsion-Start Induction Motors start heavy loads with low current

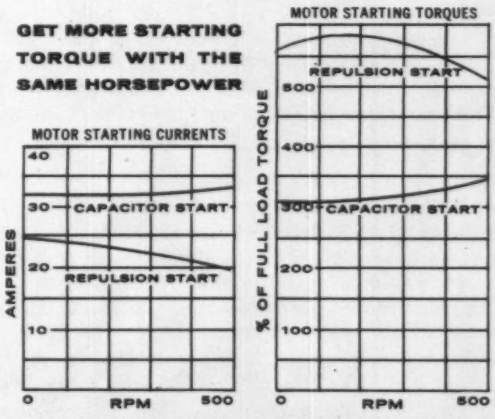
The Wagner Type RA is the work-horse of the single-phase motor field. It combines high starting torque for quick, easy starts with low starting current and minimum light flicker. It has a constant high operating speed, even under overload, and a flat efficiency curve over a wide operating range.

You practically eliminate service problems when you power tough single-phase applications with Wagner RA Motors. They have unmatched ability to start high inertia or heavy friction loads repeatedly and they give many years of unfailing service.

Let a Wagner Sales Engineer show you how these motors can be applied to your needs. Call the nearest branch office or write for Bulletin MU-220.

Wagner Electric Corporation
6400 Plymouth Ave., St. Louis 14, Mo.
BRANCHES AND DISTRIBUTORS IN ALL PRINCIPAL CITIES

GET MORE STARTING TORQUE WITH THE SAME HORSEPOWER



ONE HP, 1750 RPM, 60 CYCLES, 230 VOLTS

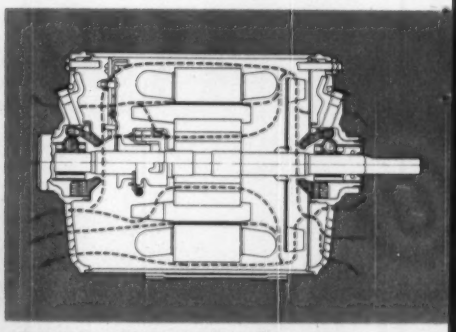
Integral Ratings, 1-5 hp are available in the latest NEMA Frame Sizes

H. P.	OLD FRAME SIZE	PRESENT FRAME SIZE
1	203	182
1½	204	184
2	224	213
3	225	215
5	254	254U

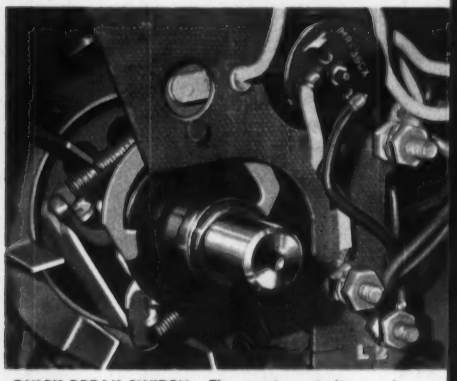
4 pole (1750 RPM, 60 cycle and 1450 RPM, 50 cycle) ratings are interchangeable in mounting dimensions with capacitor start motors of the same ratings.

Got a Normal Starting Application?

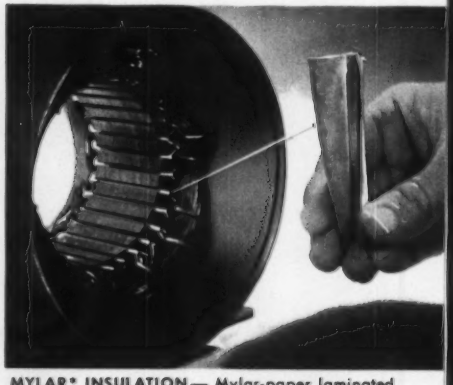
Single-phase
Type RK
⅙ through 5 hp.



EFFICIENT COOLING SYSTEM—The improved ventilating system used in these motors directs a large volume of air through the motor to effectively reduce temperatures and add to motor life. Cross section above indicates direction of air flow.



QUICK BREAK SWITCH—The starting winding and capacitor are disconnected from the line by this Wagner Switch—test-proved to make more than a million makes and breaks . . . the equivalent of two starts per hour for 50 years.



MYLAR* INSULATION— Mylar-paper laminated slot insulation gives top protection against moisture, adds thermal stability, to give more application versatility and longer life when unexpected overloads occur.

*DuPont Trademark

WAGNER CAPACITOR-START MOTORS provide dependable starts... long troublefree life

Here's the single-phase general purpose motor that gives more horsepower with less bulk—is rugged enough to permit direct mounting, compact enough to fit in tight spots. Available with sleeve or ball bearings — with rigid bases or with resilient mountings for exceptionally quiet operation.

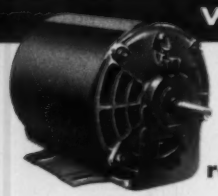
ALL-ANGLE OPERATION

The sleeve bearing design in fractional hp ratings, has a positive lubrication system that permits operation in any position. All angle mounting can mean important savings in initial costs to manufacturers—can help the design engineer in a tight spot.

You can get these motors from leading motor distributors in your community and from Wagner Sales Offices in 32 principal cities. Your Wagner Sales Engineer will be glad to help you select the right motor for your application. Wagner Bulletin MU-217 gives full details.

Wagner Electric Corporation
6400 Plymouth Ave., St. Louis 14, Mo.
BRANCHES AND DISTRIBUTORS IN ALL PRINCIPAL CITIES

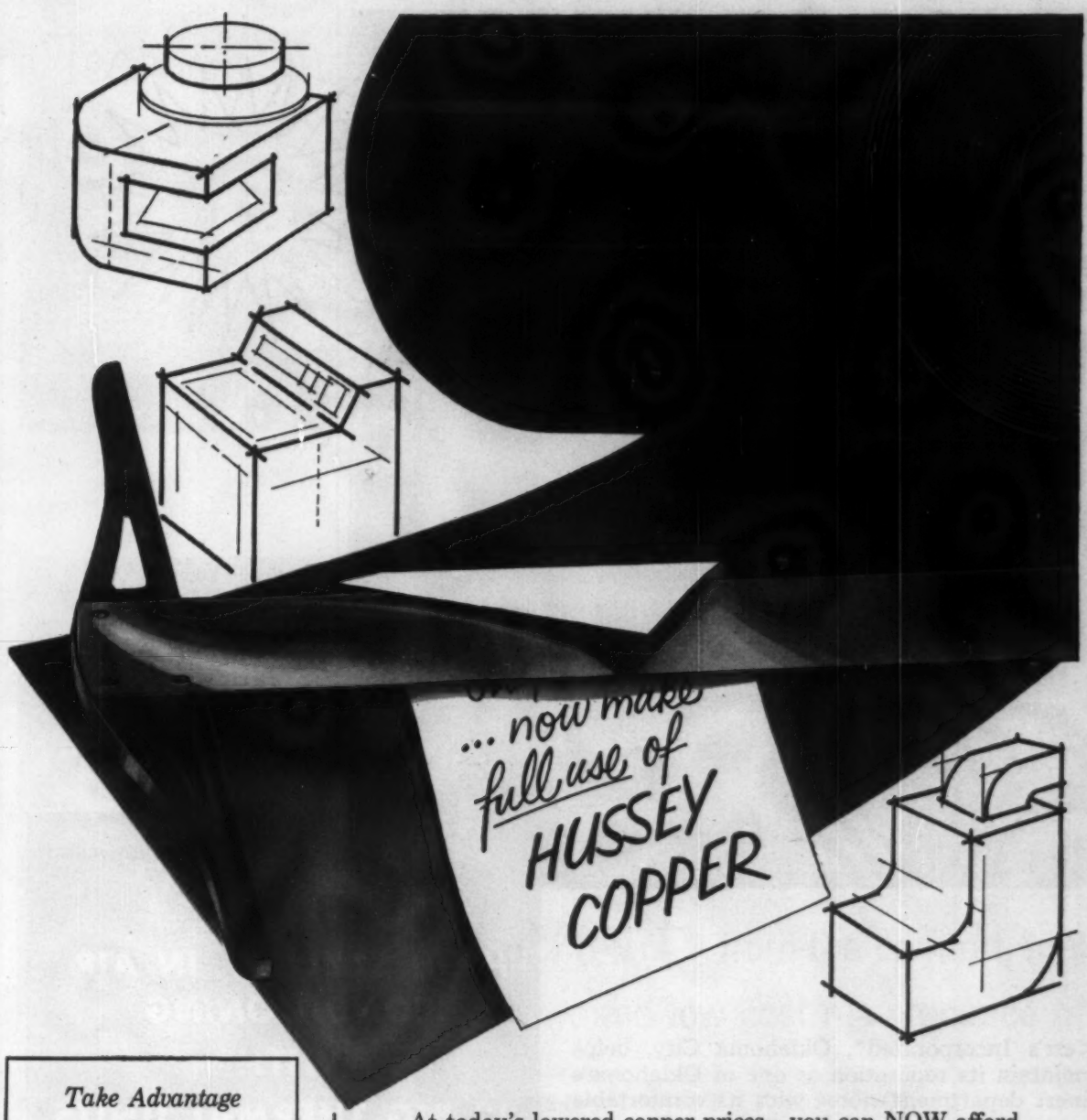
WAGNER "48" SPLIT PHASE MOTORS . . . 1/6, 1/4, 1/3 hp.



for low starting torque requirements

If you need a small fractional horsepower motor for use on fans and blowers or on a wide variety of easy-to-start machines and appliances, you can't beat the Wagner "48" Type RB Motor. It offers all the advantages of the Type RK described above, with the exception of high torque capacitor starting. This smaller, lighter, limited use motor can solve many application problems economically.

WM58-8



Take Advantage of these Superior Properties

Electric Conductivity
Flexibility
Thermal Conductivity
Weatherability
Corrosion Resistance
Ease of Fabrication
Efficient Plating
Lifetime Durability
High Finish
Lasting Beauty

At today's lowered copper prices—you can NOW afford to use Copper and Brass wherever the benefits and properties of these metals are desirable.

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C. G. HUSSEY & COMPANY
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ROLLING MILLS & GENERAL OFFICES
PITTSBURGH 19, PA.

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HIGH STYLE . . . IN AIR CONDITIONING WITH 22 BIG THERMAL UNITS

Kerr's Incorporated*, Oklahoma City, helps maintain its reputation as one of Oklahoma's finest department stores with its comfortable year around Thermal Engineering air conditioning. Twenty-two big Thermal central plant units effectively combat the rapid variations of Oklahoma weather by maintaining an always delightful climate throughout the entire building.

Thermal Engineering manufactures a quality line of air conditioning equipment for every type of structure. Write for complete information on central plant and multizone conditioners, sprayed coil units, heating and ventilating units, heating and cooling coils, and air-cooled condensers.

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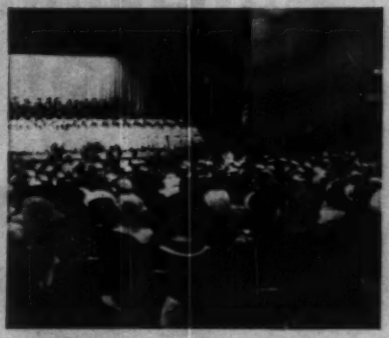
Powers DAY-NIGHT Thermostats are adjustable for normal temperature during occupancy and lower economical temperature during unoccupied periods.



All benefit.. from the comfort, fuel economy, and low cost maintenance of

POWERS Quality System of Temperature Control

Powers Control helps reduce school costs. Economical DAY-NIGHT thermostats stop fuel losses due to wasted heat in unoccupied rooms and over-heating in occupied rooms.

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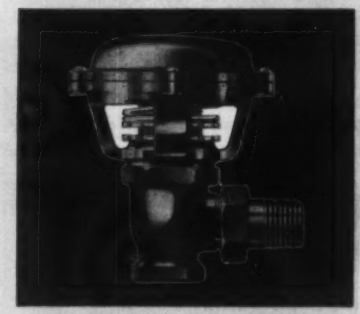
In your new school make sure taxpayers get the biggest return on their investment in accurate temperature control. Ask your architect or engineer to include a time-proven Powers Quality System of Control.



Powers PACKLESS Control Valves prevent water leakage, banish packing maintenance and give better control due to reduced valve stem friction.

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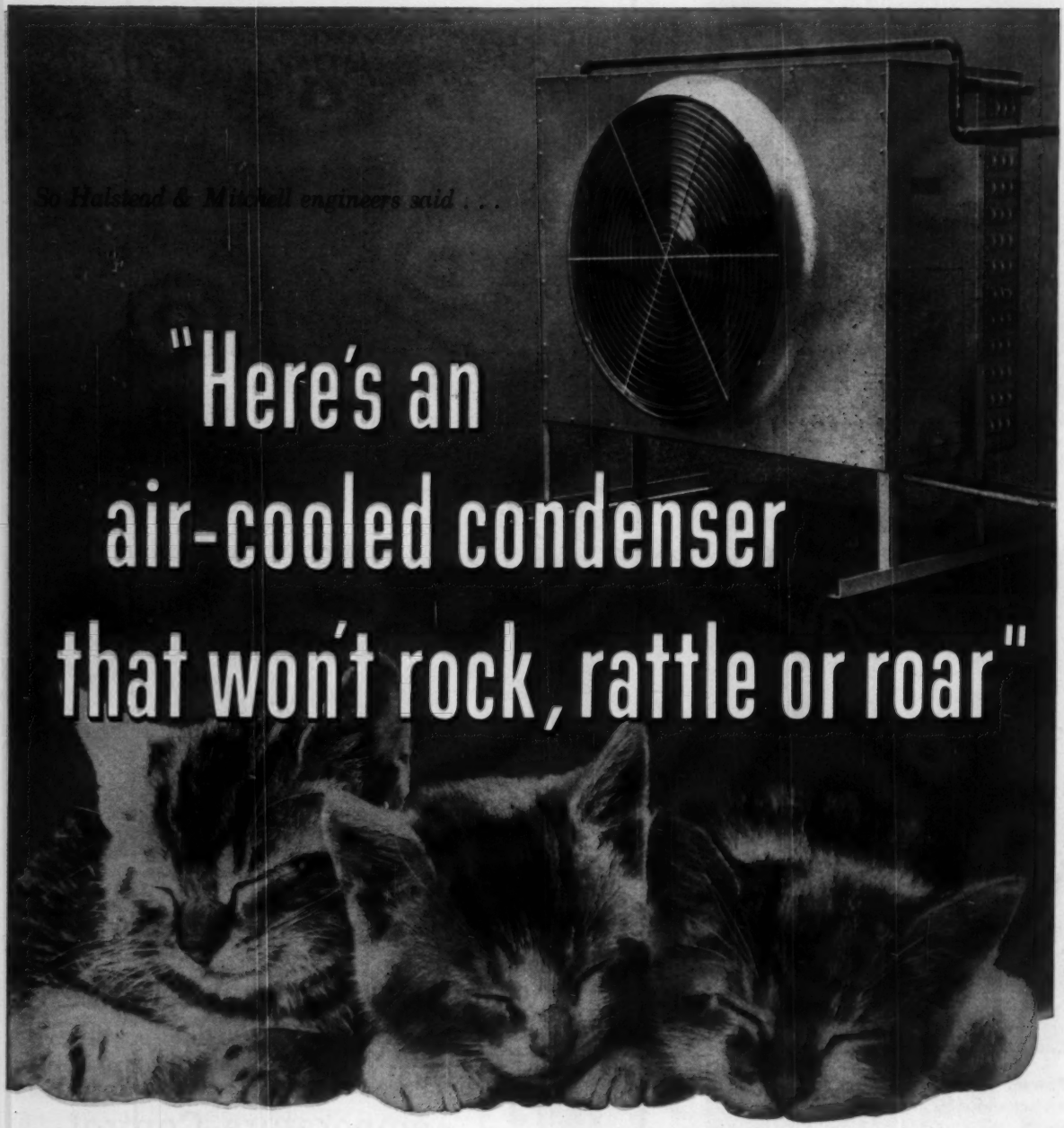

They planned it that way. H&M Air-Cooled Condensers had to be free of the vibrations, rattles and fan noise that plagued so many competitive models. And comments from contractors and users prove they hit their target.

The extra rugged casing won't loosen with use. Lock-tight construction avoids annoying rattles. Four-bladed, deep pitch fans are driven at slow speed for really quiet operation.

Halstead & Mitchell condensers are dependable, too. Large coil and exclusive Turbu-Flo design add more surface, improve heat transfer by up to 15%. Wide fin spacing prevents condenser clogging by dirt or other air-borne particles.

Designed for use with Refrigerants 12 or 22, H&M Air-Cooled Condensers are available in twelve models, from 3 to 50 tons capacity. Floor or ceiling mountings. Multiple circuiting for specified requirements, at no extra cost. Centrifugal Fan models are available for inside installations requiring ductwork.

Ask for H&M Air-Cooled Condensers at your distributors, or write for literature. Halstead & Mitchell, Bessemer Bldg., Pittsburgh 22, Pa.

HM
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Air-Cooled Condensers • Cooling Towers • Water-Cooled Condensers • Finned Coils

FOR THOSE BIG AIR CONDITIONING JOBS...

Compressors from the BIG BRUNNER LINE

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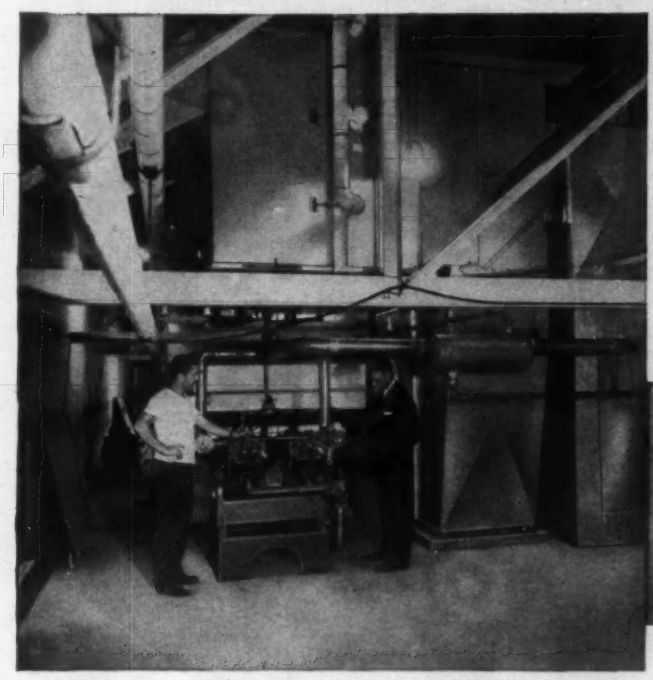

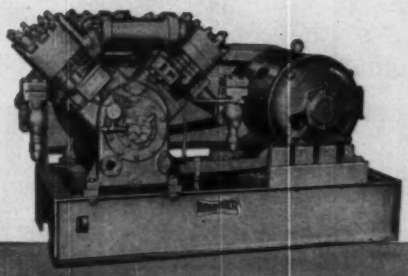

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- LOW AND HIGH PRESSURE TYPE CONTROL.
- FORCE FEED LUBRICATION.
- PRESSURE RELIEF SAFETY VALVE.
- MODULATION AND UNLOADED START (optional).

Typical of the BIG air conditioning jobs where architects, consulting engineers and contractors have learned to rely on BRUNNER compressors is the new Bostitch plant in East Greenwich, Rhode Island.

75 HP compressors, 100 HP compressors—whatever the size requirement—there was a Brunner unit to satisfy the design conditions.

Rugged workhorses of the various air conditioning systems at Bostitch, these units are tied-in to Dunham-Bush evaporative condensers and serve ceiling mounted air handling units for the Stapling, Engineering and Drafting departments. They also serve Dunham-Bush multizone units for conditioning executive offices and cafeteria areas.

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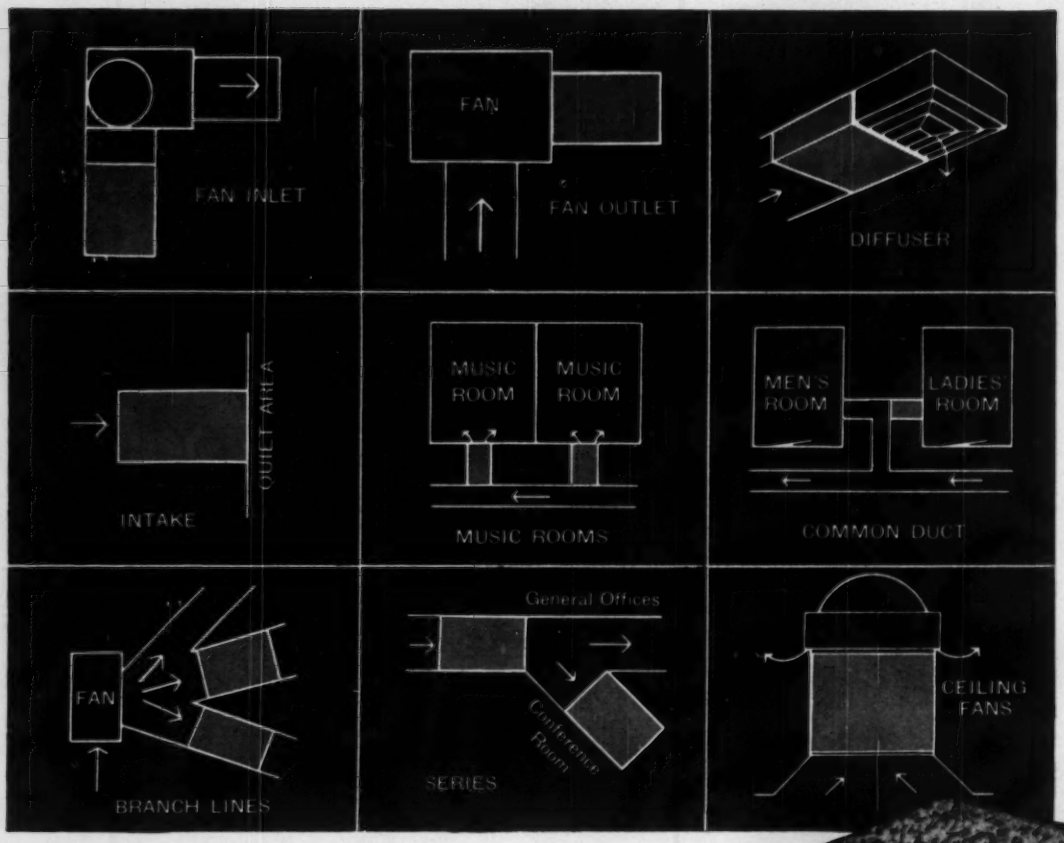
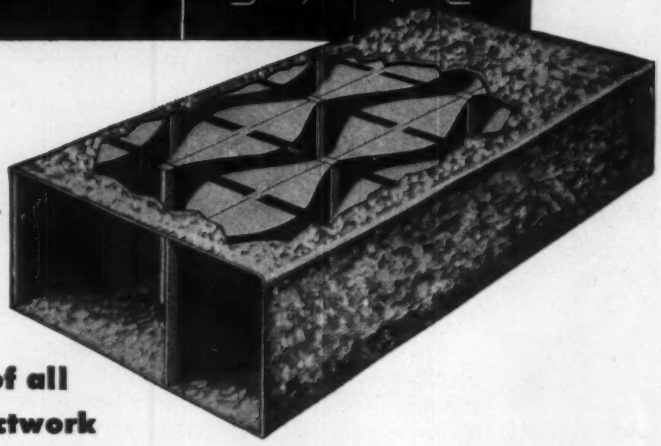


Every Building Needs *Aircoustat* Sound Traps



AIRCOUSTAT silences all noise of all frequencies traveling through ductwork

Eliminate disturbance, distraction and irritation caused by noises escaping from one area to another through ductwork.

Install AIRCOUSTAT Sound Traps. AIRCOUSTAT eliminates guesswork, wasted space and unnecessary expense of duct lining. You can guarantee your client trouble-free performance. You can estimate with complete confidence the performance of particular applications. If AIRCOUSTAT fits geometrically, it fits acoustically.

AIRCOUSTAT saves you space. Its greater effectiveness permits smaller-sized ducting. It eliminates bulky mufflers.

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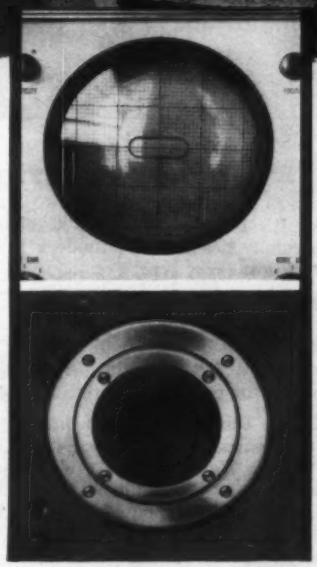
Engineered Products Sold with *Service*

the meaning of custom-made quality in aluminum, brass, and copper tube



One "peep" on the United electronic scope signals the slightest flaw or variance within specifications.

As a safeguard, any deviation is noted by an audible "beep". United Eddy Current testing automatically rejects inferior tube.

At United . . . the "BEEP" and the "PEEP" of Electrical Eddy Currents lavish special care on your tube order

Eddy Current electronic testing — with equipment developed by United engineers — detects those flaws in seamless tubes which are invisible. Another reason why for the highest quality in thin wall or standard aluminum, brass, and copper tubing, always specify United. For details, samples, and fast shipment, write, wire or phone;

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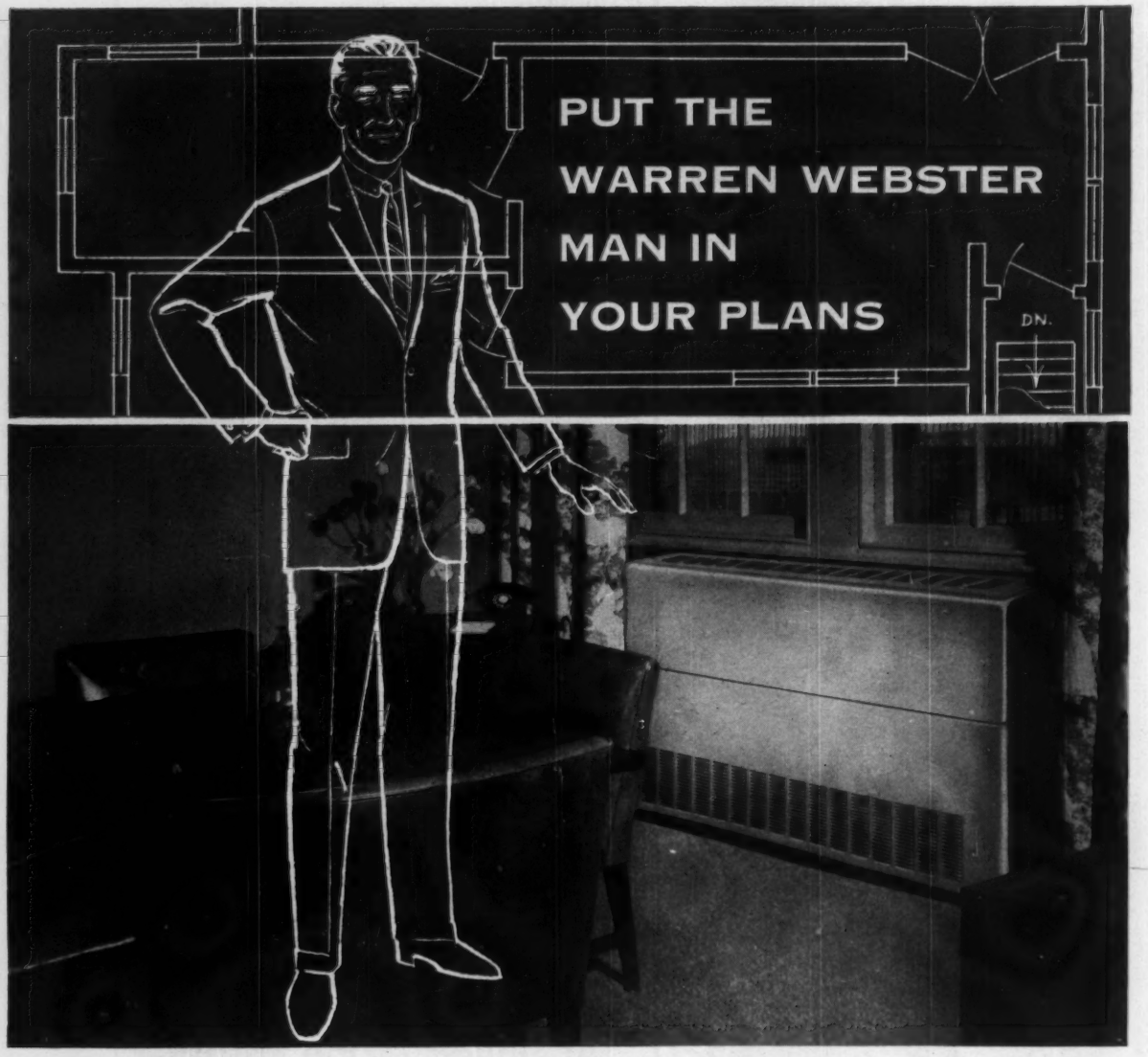
Specify **UNITED** *for aluminum, brass, copper tube and wire...brazing alloys*



Distinctive NEW Cabinet Heaters...Right for so many jobs!

It's here! It's NEW! It's the Deluxe Series Cabinet Heater line by Warren Webster, especially designed for modern HYDRONICS heating, for buildings of almost every type.

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- Heavy-gauge furniture steel cabinets finished in gray-green hammertone baked-on enamel for permanent, scuff-free beauty

For complete details on this exciting new line of Webster Cabinet Heaters — and the all-new matching Deluxe Series Cabinet Air Conditioners — see your Warren Webster Man, or write for Bulletins B-1740 and B-1750. Warren Webster & Company, Camden 5, New Jersey. Since 1888. Offices in principal U.S. cities and Canada.

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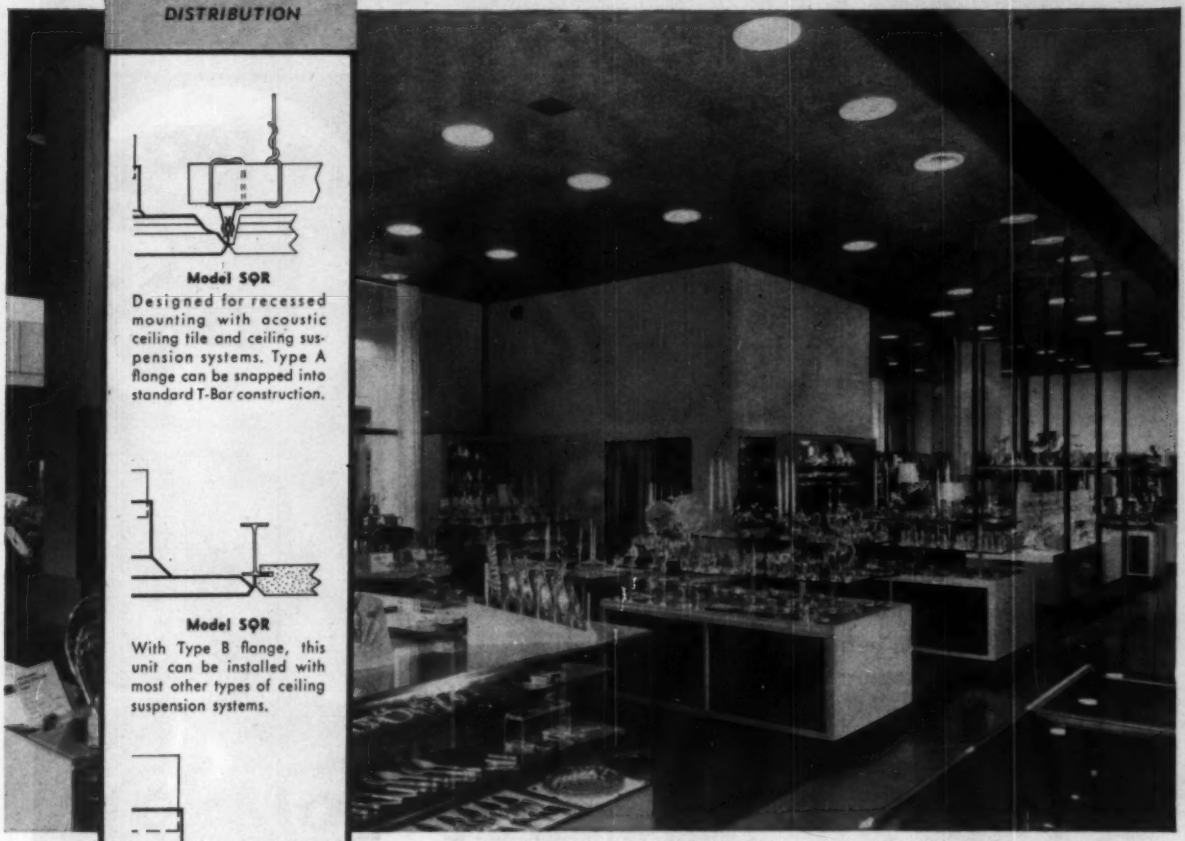
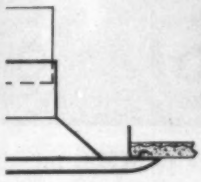


Model SQR

Designed for recessed mounting with acoustic ceiling tile and ceiling suspension systems. Type A flange can be snapped into standard T-Bar construction.

Model SQR

With Type B flange, this unit can be installed with most other types of ceiling suspension systems.



Model SQS

Provides a one-inch flange to cover opening irregularities — can be used with any type of ceiling.

Designed for optimum performance while remaining unobtrusive, Uni-Flo Square and Rectangular Ceiling Diffusers provide rapid diffusion at low sound level. Draft-free delivery guaranteed when used in accordance with published data. Ceiling smudge minimized. Contact your nearby Barber-Colman field office or write for Catalog F 6597-1. For best results, specify combined Air Distribution and Automatic Controls by Barber-Colman.

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Other experienced executives of Industrial Combustion, Inc., are: Howard McCoy, vice-president in charge of engineering; Robert Harland, secretary; and William J. DeMuth, sales manager.

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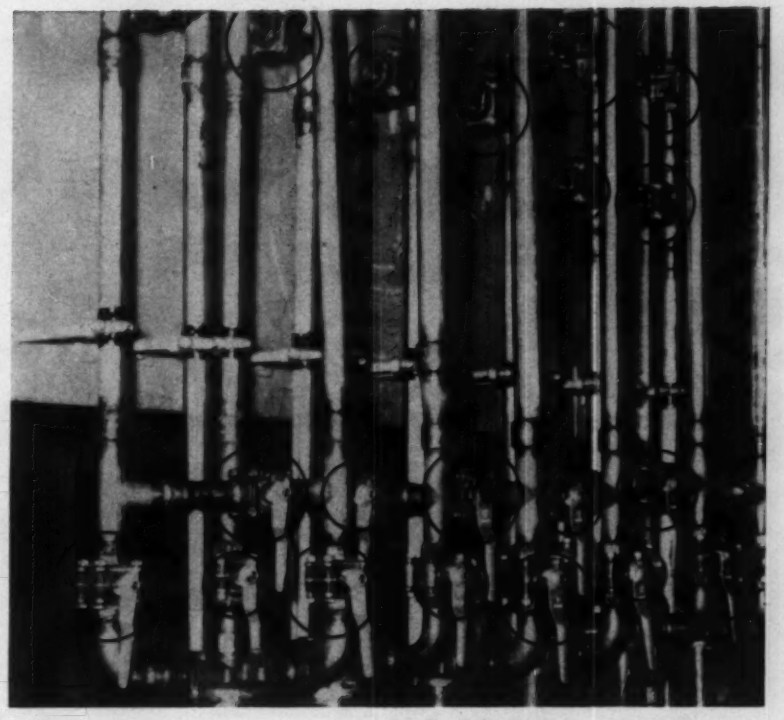
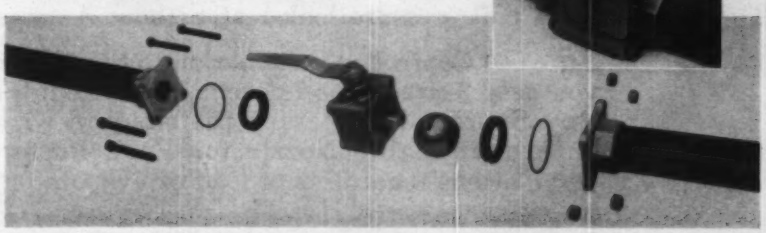


Only the ECON-O-"MISER" Ball Valve was able to solve this problem for PathéColor, Inc.

THE PROBLEM: To find a valve that would meet all of the following requirements:

1. Quick visual indication of position and quarter turn operation. 2. Excellent flow characteristics and positive shut-off. 3. The advantages of flange construction without the bulk and weight of conventional flanged valves. 4. Easy & quick disassembling for low cost maintenance. 5. The most compact and economical installation of Type 316 stainless steel valves possible.

SOLUTION: *Specifying* and *installing* Worcester's Econ-o-"miser" Ball Valve. In so doing PathéColor found a valve that provides a positive seal, a flanged construction much more compact than conventional valves that could be socket welded. In addition many unions and companion flanges were eliminated with the overall result that savings on this installation alone amounted to many hundreds of dollars.



Valves available, ¼"-2", in following standard materials*: Bronze, Aluminum Bronze, Aluminum, Carbon Steel and Types 303 and 316 Stainless Steel. Standard Seat and O-Ring materials*: Buna-N, Neoprene, and Teflon.

**Other materials available on request.*

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BUY SPORLAN REFRIGERANT DISTRIBUTORS *with the Famous* INTERCHANGEABLE NOZZLE!

the PEAK PERFORMANCE design with

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So...Get Controlled Distribution to EVERY Circuit, whether you need 2 circuits or 2 dozen...1 distributor or a thousand. Buy Sporlan Refrigerant Distributors with the famous Interchangeable Nozzle for Peak Performance on all installations regardless of load or evaporator temperatures.

Better still...Install the famous Sporlan combination of Catch-All, See-All, Solenoid Valve and Thermostatic Expansion Valve along with it and get Peak Performance right down the line!

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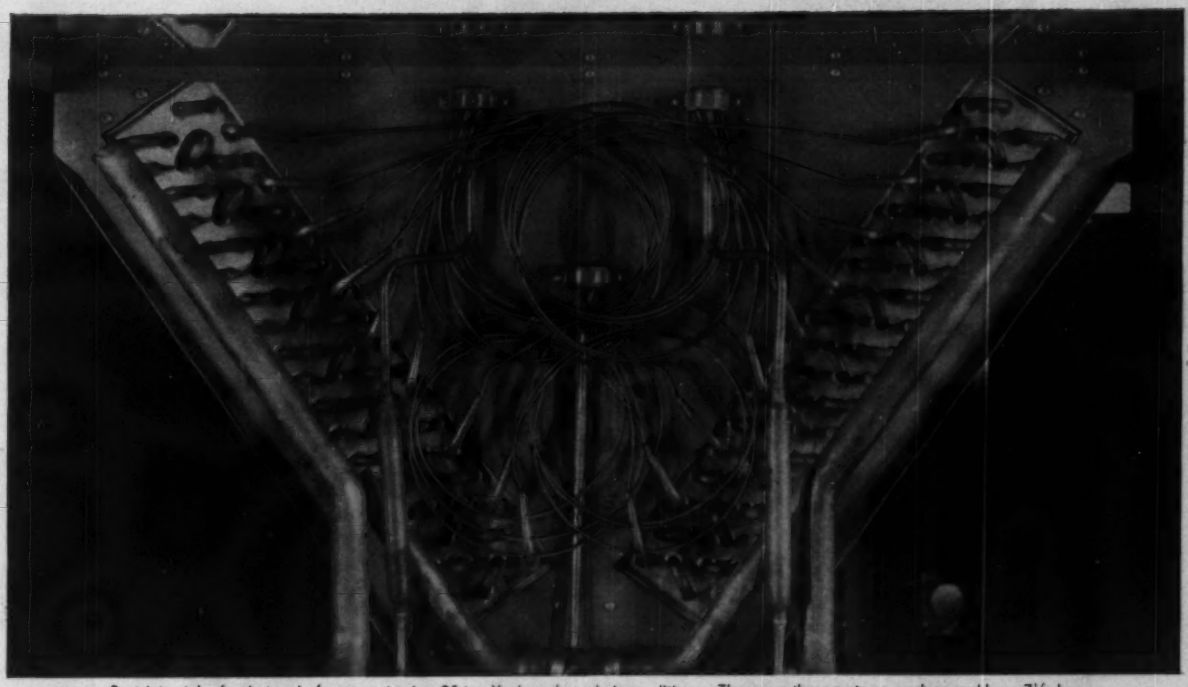
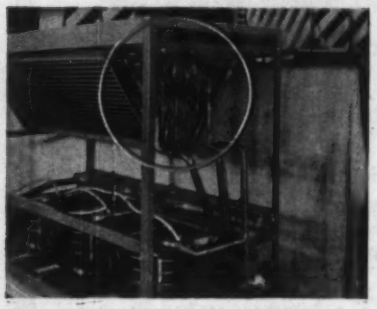


Restrictor tube feed at end of evaporator in a 25-ton York packaged air conditioner. There are three systems, each served by a 7½-hp hermetically sealed compressor unit with a water-cooled condenser—making possible step-start and step-capacity operation.

York uses restrictor tube metering in units up to 25 tons—depends on clean, uniform restrictors



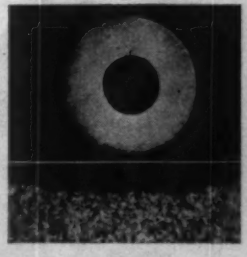
Area circled is location of restrictor tube feed shown in photo above.

RESTRICTOR TUBES, in 38 different combinations of length and diameter, play a vital role in packaged air conditioners produced by York Corp., a subsidiary of Borg-Warner. York pioneered in the air conditioning application of hermetically sealed refrigeration systems, which it uses in units up to 25 tons in cooling capacity. And these systems utilizing restrictor tubes for the metering of the refrigerant, eliminating moving control parts, have greatly reduced field service and made possible the 5-year protection plan on all units.

For dependable operation—and for economical manufacturing—York must have restrictor tubes that are clean and uniform, batch after batch. Anaconda restrictor tubes have been consistently meeting these requirements.

Consistently high quality. All Anaconda Restrictor Tubes are plug-drawn to finish. Extreme care is exercised in making the steel plugs, in order to produce a smooth, round inside bore as shown in the cross-section micrographs, right. Every length is chamfered at both ends, inside and out. Each tube is thoroughly washed and blown out, given a final air-flow test, carefully bundled, with ends of each bundle wrapped. Your range of selection is broad, as Anaconda Custom-Made Restrictor Tubes are made in both copper and aluminum, in nominal inside diameters from .025 inch to .090 inch.

Write today on your company letterhead for the free Anaconda Air Flow Slide-Rule Calculator. Address: French Small Tube Division, The American Brass Company, Box 1031, Waterbury 20, Connecticut. 6821



A cross-section of an Anaconda Copper Restrictor Tube, .081" O.D. x .031" I.D., magnified 10X. Note the roundness of the bore.

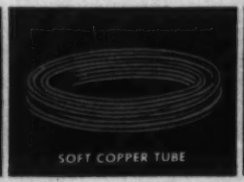
Section of a micrograph at 200X magnifications to show smoothness of the bore.

ANACONDA®

RESTRICTOR TUBES

Made by French Small Tube Division *of* The American Brass Company

ANACONDA PRODUCTS FOR THE REFRIGERATION AND AIR-CONDITIONING INDUSTRY



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General Contractor: Turner Construction Company

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SNAP*ON, the one-piece pipe insulation molded of fine glass fibers that simply snaps over the pipe . . . is *permanent* . . . and possesses the highest thermal efficiency of any pipe insulation for temperatures below 350°. Available plain or jacketed, in 3-foot or 6-foot sections in sizes up to 33″.

For information, see Sweet's File, or call your local G-B distributor (listed in the Yellow Pages).

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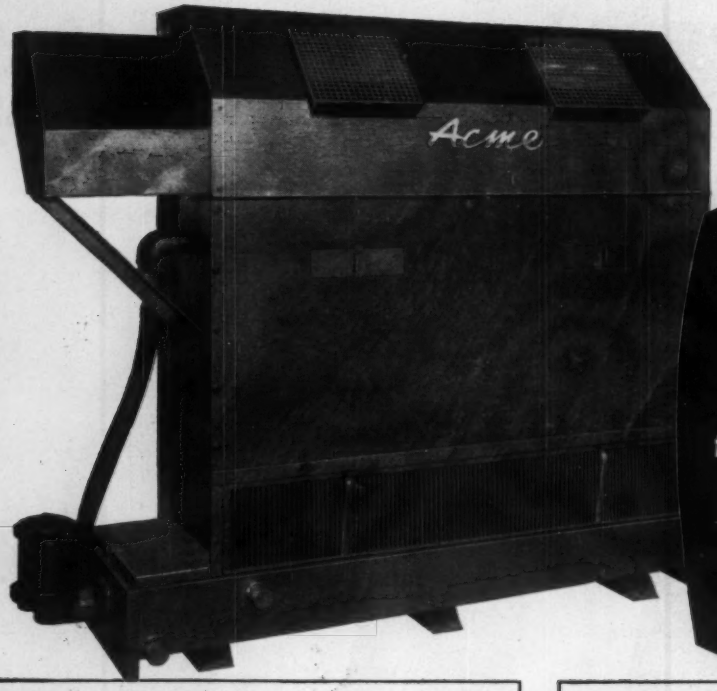
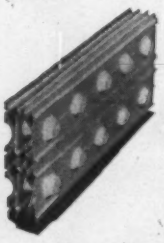


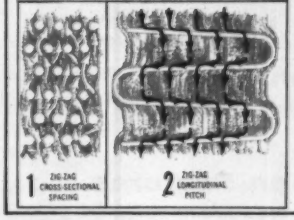
6 GOOD REASONS WHY you should specify the NEW Acme FLOW-MIZER® COOLING TOWERS and EVAPORATIVE CONDENSERS

1 New Plastic Pak weighs 90% Less in FLOW-MIZER TOWERS!



The new all-plastic Acme-Pak makes Acme towers lighter, more economical than ever. In an average unit (100-ton), the entire pack now weighs only 180 lbs as against 2300 lbs for a comparable steel pack! This means real savings on installations and on freight. Better still, it can never rot nor rust . . . . is cleaned more quickly, less frequently. Total savings are two-fold: lower installed cost, lower maintenance cost.

2 Zig-Zag coil spacing means greater capacity, less HP in NEW FLOW-MIZER evaps



Acme's zig-zag spacing improves coil efficiency in two ways. (1) By staggering the tubes, air and spray water travel a longer zig-zag path, effecting greater turbulence and better heat transfer. (2) By sloping the tubes longitudinally, spray water remains in longer contact with each tube. Also, the condensed refrigerant drains more rapidly. The result is more efficient evaporation . . . which means more capacity in less space with less blower hp.

3 Twice as much surface protection

Acme's hot-dip galvanizing *after* fabrication deposits twice the thickness of zinc that ordinary electroplating does. This double protection against rust leaves no surface exposed. Units never need painting.

4 Easily serviced external sump

On both cooling towers and evaps, Acme's external sump provides quick easy access. Sediment screen, float valve, and water treatment facilities are reached by lifting the cover.

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6 Balance where it counts

After final assembly, All Acme blower units are now electronically balanced to assure quiet, smooth operation at all times . . . less wear on blower bearings . . . greater efficiency . . . longer trouble-free service.

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Packaging that's easy to stock and use.

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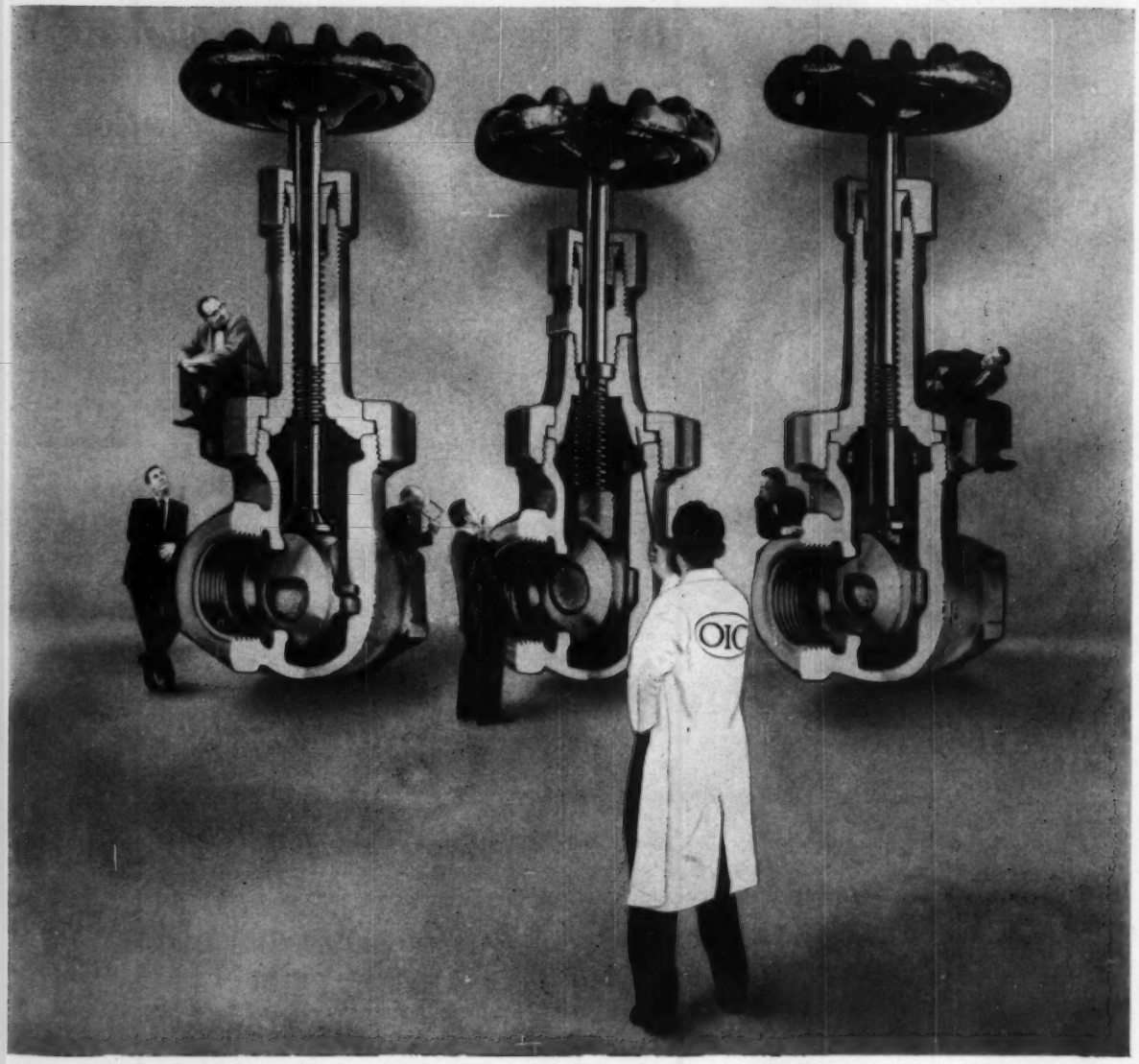
...3 gate valve types in 3 pressure classes, gentlemen, all with safe, efficient (and effective) union ring joints



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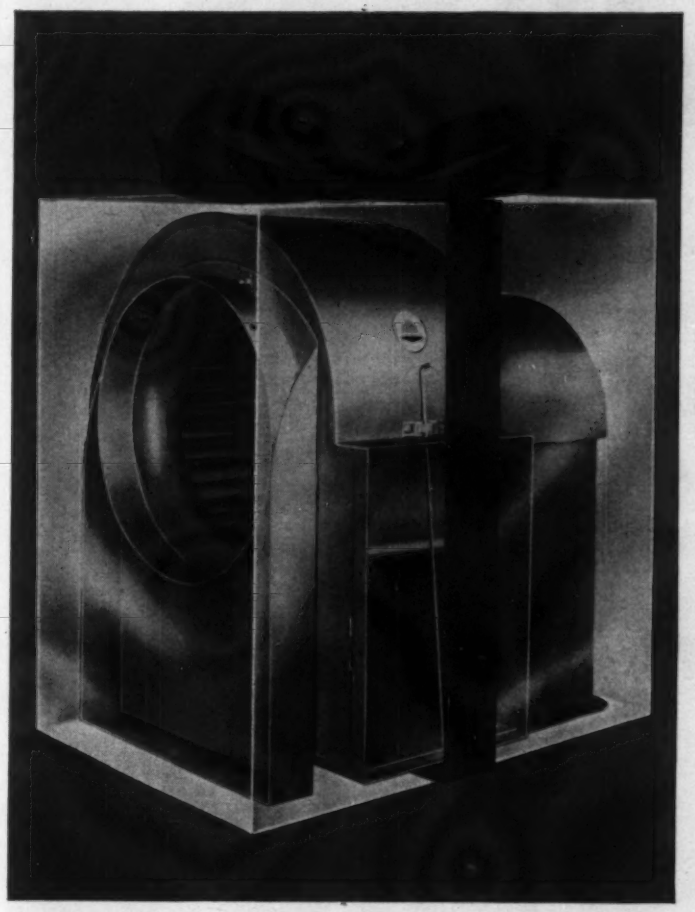

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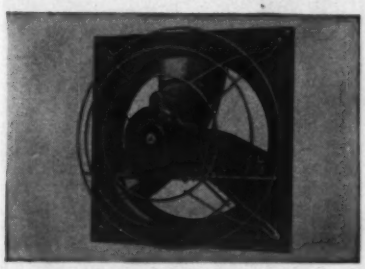

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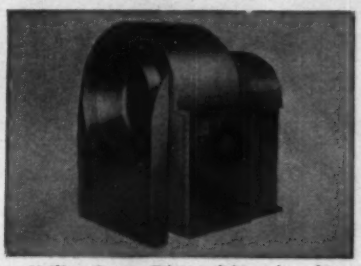

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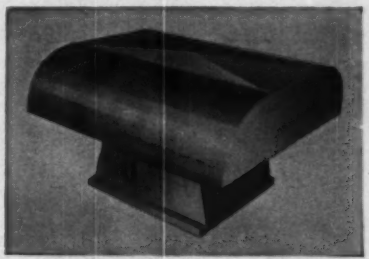

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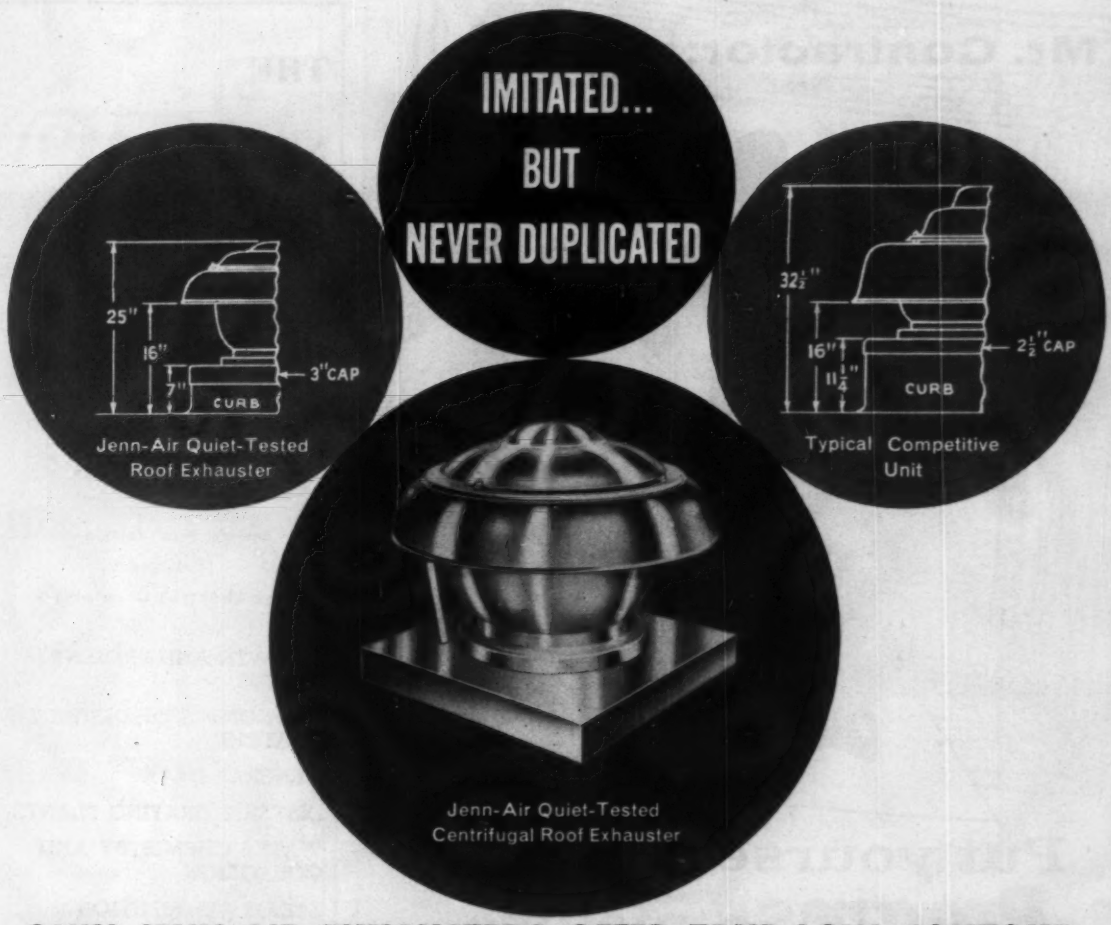

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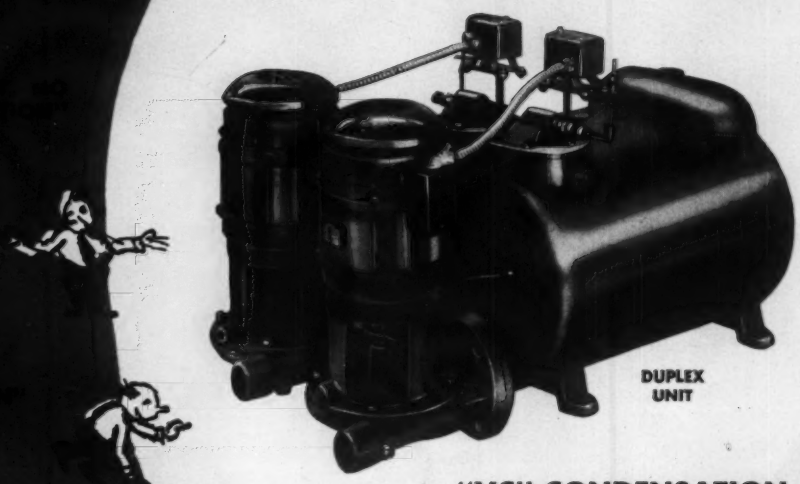

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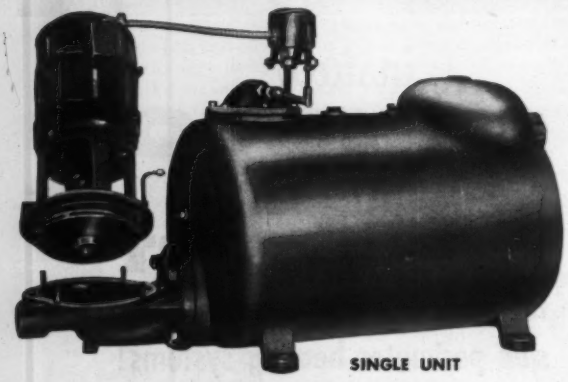

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Utility Peak Load Reverses to Summer

. . . for first time

INCREASED air conditioning on top of the year 'round heavy industrial daytime loads caused the 1957 summer load to be greater than the usual winter load, according to the Commonwealth Edison Co., Chicago.

Because of mild weather during the 1957 Christmas season and declining industrial activity, the winter peak load failed to exceed the August 15 summer peak of 3,832,000 kw as anticipated. This was the first time in the history of the system that the summer peak exceeded that of the following winter. The winter peak load of 3,774,000 occurred on December 11, 1957. ∓

Construction Spending Maintains Record Level

. . . In January, February

NEW CONSTRUCTION activity declined as usual in February, but the $3.1 billion of work completed was slightly above the previous February record set in 1957, according to preliminary estimates of the U. S. Depts. of Labor and Commerce.

The construction outlays in February brought the total for the first two months of 1958 to $6.3 billion — an all-time high for the January-February period.

Both private and public construction shared in the $142 million gain over the first 2 months of 1957.

Private spending for new construction in January and February this year was up slightly from the same 1957 months — by 2 per cent — to a record total of $4.6 billion. Outlays during the two month period of 1958 were at a record high for office buildings, hospitals, social and recreational buildings, and for gas and electric power utilities, while church building activity was at the same peak level reported in 1957 for these months.

At the same time, the dollar value of new housing, which had been below year-earlier levels since the close of 1955, totaled virtually the same in the first two months of 1958 as in the like 1957 period. The only significant declines in the private sector from last year were in outlays for new industrial plant and store building.

Public construction expenditures thus far in 1958, totaling $1.7 billion, were 4 percent above last year's record for the January-February period. Most of this gain was in public housing. Also at a new high for the period was public school building which was up 5 percent from a year ago. ∓

Big Air Conditioning Up 15 Percent in 1957

. . . over 1956

AIR CONDITIONING for large buildings showed a bigger gain in 1957 than in any other previous year, according to the Air-Conditioning and Refrigeration Institute. Also, the installation of large air conditioning has a great potential for the future.

The installed cost of central station air conditioning systems in large multiroom buildings and commercial and industrial applications in the U. S. during 1957 was estimated to be $598.9 million, as compared with $528.18 million for 1956. This gain represents about 15 percent.

The potential for air conditioning in the industrial field is estimated to be five times the potential in both multiroom building and commercial building. Only about 5 percent of factories, plants, and other industrial establishments now have air conditioning, but as management recognizes the economic benefits of air conditioning through improved health and morale, lower rates of absenteeism, increased efficiency, and greater production, this market is becoming increasingly important.

Installed value of systems put into operation each year since 1950, based on figures reported to the ARI, is estimated at:

1950	$241,770,000
1951	278,200,000
1952	252,920,000
1953	295,040,000
1954	378,810,000
1955	434,120,000
1956	528,180,000
1957	598,900,000

∓

Future Construction Contracts Show Decline

. . . sharpest drop in more than a year

CONTRACTS awarded for future construction in the U. S. during January registered the sharpest decline in more than a year, according to the F. W. Dodge Corp.

January 1958 contracts totaled $2,066,059,000, a drop of 10 percent from January 1957. The extent of the decline was widespread, with nearly every major category showing a decrease.

Contracts for nonresidential buildings in January 1958 were valued at $758,711,000, down 17 percent from the comparable month last year. Within this category, manufacturing buildings registered the sharpest drop, with contracts running 53 percent below a year ago.

Commercial and educational building contracts showed declines of 6

and 4 percent, respectively. Contracts for hospitals and religious buildings were down substantially.

Apartment building contracts continued to show strength, but the total of residential building contracts in January 1958 was 5 percent below the January 1957 level. ⫩

Establish Color Code For Instrument Tubing

. . . urge industrywide adoption

A UNIFORM color coding of pneumatic tubing on instrument panels has been established by the Instrument Society of America.

The new code urged for industrywide adoption is as follows: air supply, red; seal, purple; set, black; alarm, green; readout, blue; transmitted, orange; controlled, yellow; all others, natural color.

A need for standardization of colors in instrument panel work has been apparent for years. A survey conducted by ISA revealed that color coding was in wide use, but there was no conformity in selecting a given color for a given service. ⫩

See Increase in Factory Comfort Cooling in '58

. . . reflecting '57 sales trend

THE GROWING BELIEF that an air conditioned factory is a more efficient factory will be reflected in increasing comfort cooling for industrial employees during 1958, predicts D. C. Minard, Trane Co. president.

The firm reports that stepped-up tempo was noticed in 1957 as its industrial sales of centrifugal refrigeration compressors more than doubled 1956 figures.

"Despite the additional installations made during 1957, less than 1 percent of U.S. factory space is air conditioned," said Mr. Minard. "However, what has happened in the office field where today all new first class buildings are air conditioned, could ultimately happen in the factory market. When it is remembered that there is 50 times greater plant space than office, the potential is very great."

He noted that today many of the large architectural and engineering firms are recommending that their factory clients install air conditioning now or provide for its addition later.

Reasons for this are that employees working in controlled temperature surroundings are more efficient and in many instances the quality of the product being manufactured is improved.

Mr. Minard noted that new products and improved methods are resulting in more economical air conditioning systems for industrial plants. Some of these methods are:

1) Recognition of the fact that it is not necessary to reduce temperatures in factories to the same degree as in offices. By designing for higher temperatures, but lower humidity, satisfactory conditions are obtained at lower costs.

2) Methods whereby air curtains are incorporated to separate nonconditioned spaces from the conditioned portion of the factory.

3) Ventilating setups which remove heat from machines and other equipment and exhaust it, thereby substantially reducing the cooling load.

4) Spot cooling only those portions of the plant in which employees are actually working. The rest of the plant is not cooled, resulting in a marked cost saving.

5) Designs which are keyed to air condition only the working zone, i.e., 10 to 12 ft of space directly above the floor. This occupied zone cooling takes advantage of the fact that cool air stays down, minimizing the cooling of overhead, unoccupied areas. ⫩

Natural Gas Reserves Continue to Climb

. . . to record 246 trillion cu ft

PROVED recoverable natural gas reserves in the U. S. climbed to an all-time record of more than 246 trillion cu ft in 1957, according to the American Gas Association.

A net gain of 8.8 trillion cu ft was the fourth greatest in the natural gas industry's history. This increase was realized even though total net production during 1957 climbed to a peak figure of 11.5 trillion cu ft.

Additions to natural gas reserves during 1957 aggregated 20.3 trillion cu ft. This included 9 trillion cu ft of new discoveries, the best year on record — surpassing the previous high of 7 trillion cu ft in 1953. Extensions and revisions of earlier estimates amounted to 11.1 trillion cu ft and an increase of 180 billion cu ft was reported in underground storage.

Estimated proved recoverable reserves have increased from 165.9 trillion cu ft since 1947, a net gain of 80.7 trillion cu ft — or nearly 49 percent. ⫩

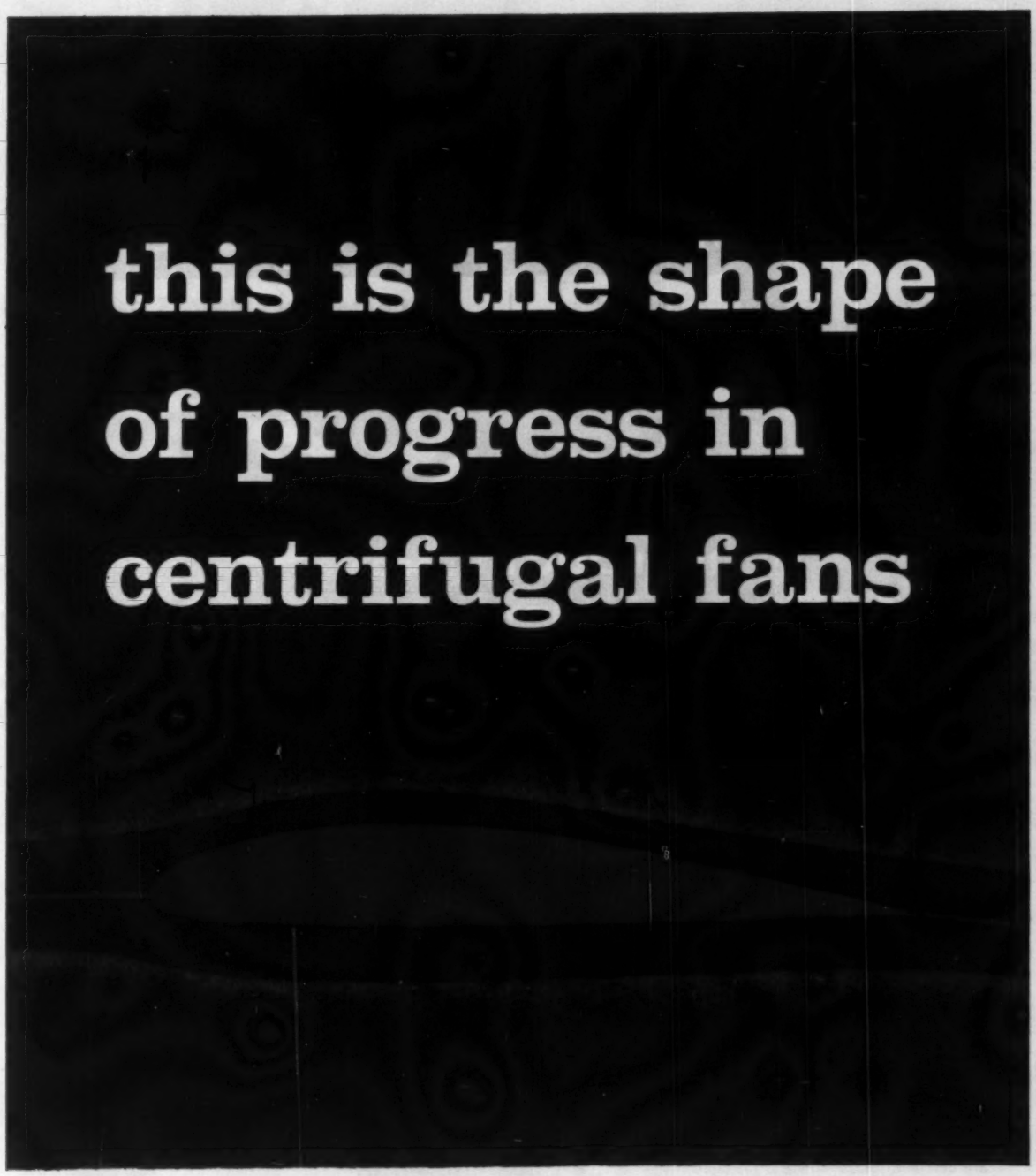
"Quote"

"Leadership is the ability to get workers interested in doing the job because they want to, not because they have to." — *Wallace E. Fore, plant engineer, Los Angeles Div., North American Aviation, Inc., at the ninth Plant Maintenance & Engineering Conference held recently in Chicago.*

Credit Original Source for Pipe Deflection Data Sheet

. . . published January

THE CHART on page 198 in the January 1958 issue of Heating, Piping & Air Conditioning is credited to Crane Co. as the original source. This chart provides data on pipe deflection and is part of the Data Sheet, *How to Space Supports for Steel Pipe.*—Ed. ⫩



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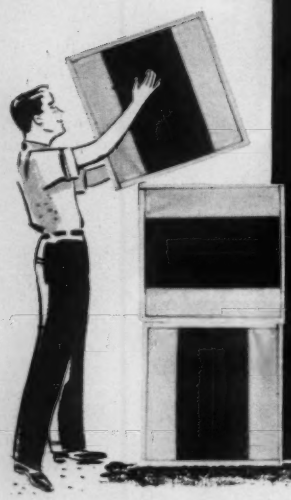

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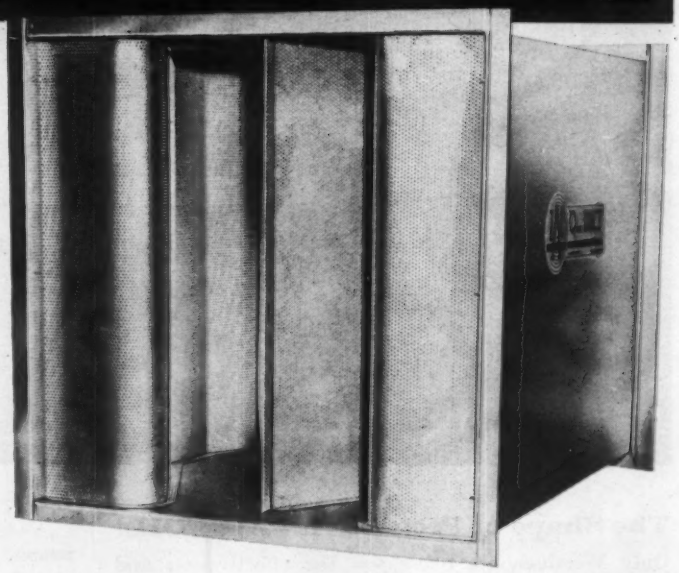

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"Open for Discussion"

• WE FOLLOW HERE each month the practice at engineering society meetings of providing an "open for discussion" period. You are urged to take part. Just address your comments to the Editors, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2.

Empirical Formula Provides Data For Vapor Transmission Results

I HAVE been interested in the answers to the question, *What Vapor Transmission Rules Apply When Planning for Dehumidification?*, which have appeared in the January and February issues. I assume that the question asked originally by H.P.W. is a practical problem. Perhaps the following results from some of our projects will be of help.

I will attempt to answer H.P.W.'s question as asked, part by part.

a) The initial rate that water vapor will enter a room is based upon the following empirical formula:

$$(A \times 300)/(14 \times L) \times \Delta \text{ gr} \times K = \text{Moisture load grains per lb per hr.}$$

where:

A = area of opening, sq ft
300 = rate of moisture travel per lineal ft at 35 gr per lb moisture difference, gr per lb per hr
14 = cu ft of air per lb. This should not be modified, regardless of actual air density
L = lineal ft of travel through opening
Δ gr = grain difference between inside and outside conditions in gr per lb
K = multiplier for moisture difference per following table:

35 gr per lb and below	1.0
40	1.11
50	1.35
60	1.58
70	1.82
80	2.05
90	2.29
100	2.52
110	2.76
120	2.99

b) The rate will vary with time elapsed because the vapor pressure difference changes between the two areas and it varies in accordance with the above formula. If two areas or volumes of infinite size are considered (or adequate dehumidification equipment is available) with a low dew point in one and a high dew point in the other, then the vapor pressure difference would remain constant and the rate of flow would be constant.

c) The time required for the entire room to reach outside vapor pressure can be calculated by differentiating the formula. Other factors, however, must be considered, such as permeation of room walls, etc., product or dunnage moisture pickup, and the rate of this pickup.

d) If a vapor pressure difference exists in the same relationship as previously stated, no reasonable outward air flow would prevent inward flow of water vapor. Water vapor will counterflow air motion since the partial vapor pressures outside and inside the room are tending to equalize independently of air flows.

WALTER E. ELLIS
Ellis and Watts Products, Inc.
Cincinnati, Ohio

See HTHW Terminology Redundant; Also, Why Call Equipment "Boilers?"

HERE IS an argument concerning terminology in connection with the use of 380 F water for heating or process work. This type of system is generally termed *high temperature hot water*, or just *HTHW*.

In my opinion, the word *hot* is redundant and should be eliminated (unless, of course, it is possible to have high temperature *cold* water).

Another objection: such installations — in which no steam in generated — are often described as having one, two, three, or more *boilers*. Since no boiling takes place, the use of the term *hot water generators* makes a great deal more sense to me. I would like to hear comments from others on this.

ERIK B. J. ROOS
Partner
Seelye Stevenson Value & Knecht
Consulting Engineers
New York, N.Y.

Why Are Air Ions Beneficial To Human Respiratory System?

THE ARTICLE, *Ions' Role in Air Conditioning Takes on New Importance*, by John C. Beckett, in the January issue, states that "air ions influence the human respiratory system" without any qualifications.

As a naturally curious engineer, I would like to know how and why this is true.

JOHN T. CARTLAND
Silas Cartland
Consulting Engineer
Park Ridge, Ill.

THE AUTHOR'S REPLY — The answer to this question can be found in the clinical observations of Dr. Igho H. Kornblueh, reported in the *American Journal of Physical Medicine*, December 1955, and February 1958. Animal studies have confirmed the more difficult observations on human respiratory systems. A University of California report by A. P. Krueger and

Richard Smith recently appeared in the Proceedings of the Society for Experimental Biology and Medicine.

I quite agree that as engineers we must know something of the how and why atmospheric electricity has an effect on our respiratory system.

Professor Krueger has been the first to show measurable change. This was accomplished in a fairly simple laboratory experiment. The cilia beat of animal trachea is increased by negative ionization and conversely decreased by positive ionization. Similar effects were observed on mucous flow. Negative ionization increased the rate at which mucous moved through the trachea. Whereas, positive ions decreased this movement and in some cases stopped it. This would appear to be the first plausible explanation of why congestion develops in the human trachea in rooms with a positive space charge. Throat irritation generally accompanies this discomfort of breathing.

Subjective evidence reported in the literature for more than 50 years shows that easier breathing occurs with negative ions in the air. There are about 500 such reports in the literature dating from 1900. It has only been recently, however, that quantitative objective evidence has confirmed the deleterious effects of positive ions on animal tissue and the beneficial effects of negative ions.

J. C. Beckett
Chief Engineer
Wesix Electric Heater Co.
San Francisco, Calif.

Swedish Underground Workshops Air Conditioned by Pioneers

I HAVE READ with interest the article, *How Underground Workshops Are Made Livable*, by Axel Rosell, in the March issue.

During my visit to Sweden a few years ago, Mr. Rosell was instrumental in making it possible for me to visit many representative underground workshops and other underground areas used for commercial and industrial purposes. I have known Mr. Rosell for a great many years. Through this association with him, I was able to see a great deal more of the varied applications of underground air conditioning than normally would be afforded a casual visitor.

While underground installations in rock exist in many parts of the world, those in Sweden are more advanced and more numerous in practical service than anywhere else. In fact, it may be said that the underground building is typically a part of the Swedish industry and economy.

Design problems have been solved as they have presented themselves in actual installations. No vast amount of research, if any research at all, forms the basis for action in Sweden. As a result, practical answers have been developed more or less by on-the-spot engineering to solve each problem as it presented itself.

The first installations, some of them over 20 years old, used air entirely as a means of heat removal. Large quantities were necessary. Space was restricted. Drafty conditions resulted, and therefore an underground installation was expected to have a handicap of draft. To the Swedish workmen the underground factory meant a drafty place to work. Hence, a great draft consciousness has been built up and, even today, has not been overcome.

Radiant cooling, which the author describes in this article, is a logical answer to the removal of heat with a minimum of air movement. Radiant cooling systems have been explored and have been applied to many comfort applications in this country. It is safe to predict that this application will increase with time.

In handling high heat loads such as those found in a manufacturing plant deep underground, a radiant cooling method is perhaps the only one which will be satisfactory for worker and process alike. Heat recovery through application of the heat pump principle further contributes to the economy of this type of installation.

It should be particularly noted that underground workshops and other types of construction in Sweden are not developed for protection alone. They have proven to be economical in operation and maintenance as well. Also, their initial cost is the same or only slightly more than that of an above ground structure.

There are geographically advantageous locations in the U. S. for the development of underground structures. Many unused mines could serve to house and protect vital industries. However, merely on the basis of economical working space, a development of the underground structure can become economically feasible only when the construction industry assumes a more realistic approach toward a reduction in cost, which seems principally based upon a difference from conventional practice.

Thomas H. Urdahl
Consulting Engineer
Washington, D. C.

See Food Process Piping Article Most Worthwhile Contribution

THE ARTICLE, *Food Process Operations Demand Maze of Piping*, by Roy M. Lazar, in the March issue, is a most worthwhile contribution. The author's discussion of the materials used, the reasons for their selection, and the methods of assembly are very interesting and informative.

Food processing has become big business and has created many requirements for special piping applications. Mr. Lazar's article adds to the information about the engineering factors that should be considered in designing, installing, operating, and maintaining this type of piping system.

C. T. Baker
Consulting Engineer
Atlanta, Ga.

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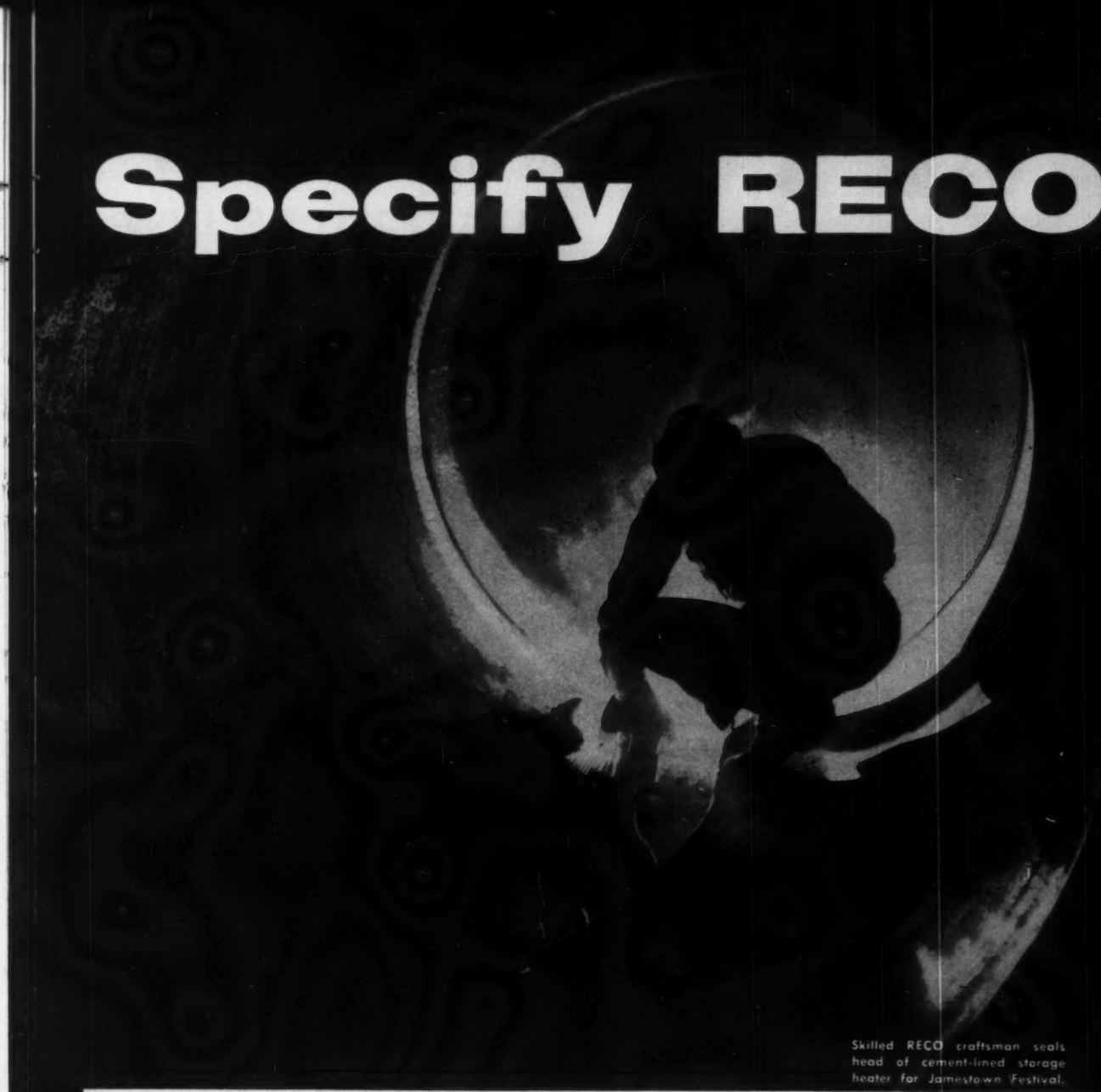

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Question of the Month

What Causes Oily Soot Problem In High Velocity Air Conditioning?

This question was asked previously in Heating, Piping & Air Conditioning and is repeated here, along with answers that have been received from readers. Other answers or comments for publication are invited.

"We have encountered an oily soot problem in our office building air conditioning system. The building consists of seven floors above a garage at grade level and below.

"The air conditioning system consists of a perimeter system for zone control, and a hot and cold deck interior system. Both systems are equipped with automatic oil type filters as well as electric precipitator type filters in series. The perimeter system air intake is at the first floor level approximately 20 ft above grade; the interior system air intake is in the penthouse on the roof.

"Oily soot of 1/16 in. diam and smaller fluffy spherical particles is discharged from the high pressure primary air ducts of the perimeter system, and from the ceiling supply units. Dust checks on the precipitators and on the cooling and heating coils fail to show any signs of the soot; target plates coated with petroleum jelly installed inside the coil and filter plenum also fail to show evidence of soot.

"Could micron size particles of soot be agglomerated into larger particles downstream of the supply fans? I would like to know what is causing this problem and how we can correct it." — W.G.M.

Check Electronic Air Filter Operation, Condition of Bearings, Oil Sources

THE oily soot problem in the high pressure air conditioning system could arise from a number of factors. Dirt, as an oily soot, can originate in one or both of the following sources: (1) the primary air stream carrying dirt through the ducts and supply outlets into the area, or (2) a secondary or induced air stream caused by the high velocity air at the diffuser.

The primary air stream for the perimeter system and the ceiling supply should be purged of dirt, dust, and lint before it reaches the outlets into the area. However, it must be remembered that no filtration system is 100 percent efficient.

I gather from the information supplied that the filtration system is designed for a highly efficient operation. The electronic precipitator in the filtration system is very efficient on certain types of dirt. However, it will not completely eliminate large particles of dirt from the air stream. Also, it will not completely eliminate particles of dirt such as lint or paper ash particles which will not readily accept an electrical charge.

Therefore a mechanical means of filtration is incorporated in the system, either before and/or after the electronic precipitator. The efficiency of this mechanical filter will depend upon the degree of filtration required. Often, however, the efficiency is overlooked for economy reasons and a less efficient mechanical filtration system is installed.

Some of the possible difficulties which could arise with the existing system are as follows:

If the velocity of the air through the filtration system is extremely high, there could be oil and/or dirt blowoff from either the automatic oil type filters or the electronic precipitator, and this oil and/or dirt could collect downstream in the ducts. Often, this will occur when there is a sudden surge or increase of air velocity through the system. This surge or increase of

(*Continued on page 92*)

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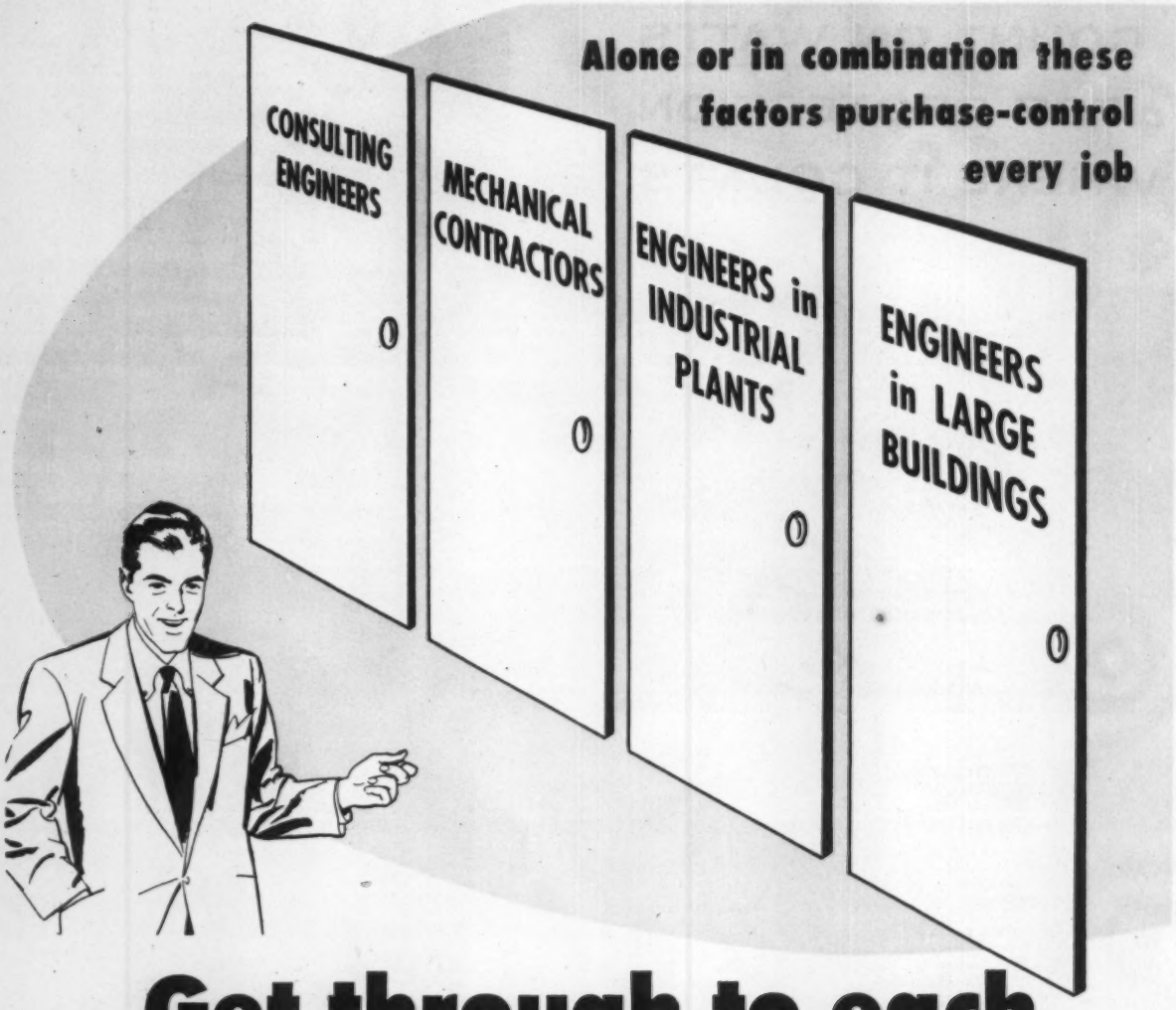
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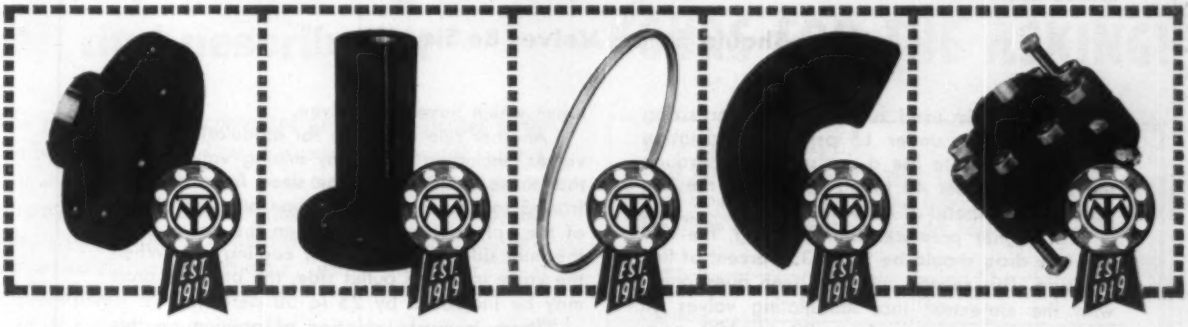

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(*Continued from page 88*)

air velocity could occur when an access door is opened or closed, the blower system turned off or on, or because of a number of other reasons.

Another possibility for unloading the precipitator is if it is shutoff for but an instant. Perhaps when cleaning the precipitator, the maintenance men turn the precipitator off first, and then the blower, which could cause a certain amount of dirt unloading.

Another cause for the difficulty could be oil or grease from the blower bearings working into the inside of the duct through the blower shaft clearance opening, and thus into the air stream. Any dirt, oil, or grease from either the electronic precipitator, the automatic oil type filters, or from the blowers themselves would collect downstream on the ductwork.

The ductwork itself could be the cause of the oily soot problem. If the building were old and the filtration equipment installed into the existing ductwork, these ducts could hold a great deal of dirt from previous operation. Even if the building were new, and the blowers were operated without having the electronic precipitator or the automatic oil type filters in operation, the dirt could still exist in the ducts. A similar situation could occur if the electronic precipitator were cleaned by unrecommended methods or in a careless manner.

Dirt resulting from the secondary or induced air stream is proportional to the cleanliness of the area. Examples of this are the dirt drawn out of the basement, through elevator shafts or open stairways, or that caused by a loosely constructed building.

I would suggest a check of the complete filtration system, including the mechanics of the system and the quantity of air flow. Also, a complete checking and cleaning of the existing ductwork should be done.

A more accurate answer could be supplied for this individual problem if more facts were available concerning the building and its air conditioning system. The Air Filter Institute has a detailed pamphlet devoted to this subject which is entitled *Streaking and Smudging Around Air Outlets*. Copies are available from the Air Filter Institute, 300 Independence Ave., S.E., Washington 3, D.C.

LARRIE L. ISENRING
Engineer
Research Products Corp.
Madison, Wis.

Ducts May Have Small Perforations Permitting Entrance of Oily Air

THE air velocity in the main and branch ducts in this type of system may range from 500 to 3000 fpm. If small holes or other perforations are present in the duct walls, an inductive effect may result whereby outside air containing all types of foreign particles may be induced into the main stream. With both systems located in close proximity of the garage, it is possible that airborne oil particles are carried into the ducts by this means.

To check for this, it is recommended that the systems be tested for air tightness. The presence of small holes and/or surface imperfections in the ducts will be indicated by an unusually high pressure reduction between distant points in each duct. This will indicate that air leakage is occurring.

H. B. WAYNE
Consulting Engineer
Woodhaven, N. Y.

READER ASKS—

"How Should Steam Valves Be Sized?"

"A commonly used rule of thumb for sizing low pressure — under 15 psig — modulating steam valves, is to use a pressure drop through the valve of from 40 to 60 percent of the line pressure just ahead of the valve.

"For higher pressures than 15 psig, the rule says the drop should be 25 to 35 percent of line pressure. This second rule has been questioned, with the statement that modulating valves on higher pressures, say from 20 to 100 psig, should be sized for a greater pressure drop than valves on low pressure lines.

"The rule further says that positive acting — two-position — steam valves should be sized for pressure drops 25 to 50 percent lower than those which have been given.

"Another rule of thumb for modulating water valves, including three-way mixing valves, says that these valves should be sized for a drop of from 5 to 15 percent of the line pressure ahead of the valve. This applies when the valve is on the inlet side of a heating or cooling coil. When the valve is on the outlet side, the pressure drop may be increased by 25 to 50 percent.

"There is much variation of opinion on this subject, and I would like to hear what other engineers have to say about this. I believe that Heating, Piping & Air Conditioning can clarify the situation by publishing these comments."
—F.A.R.

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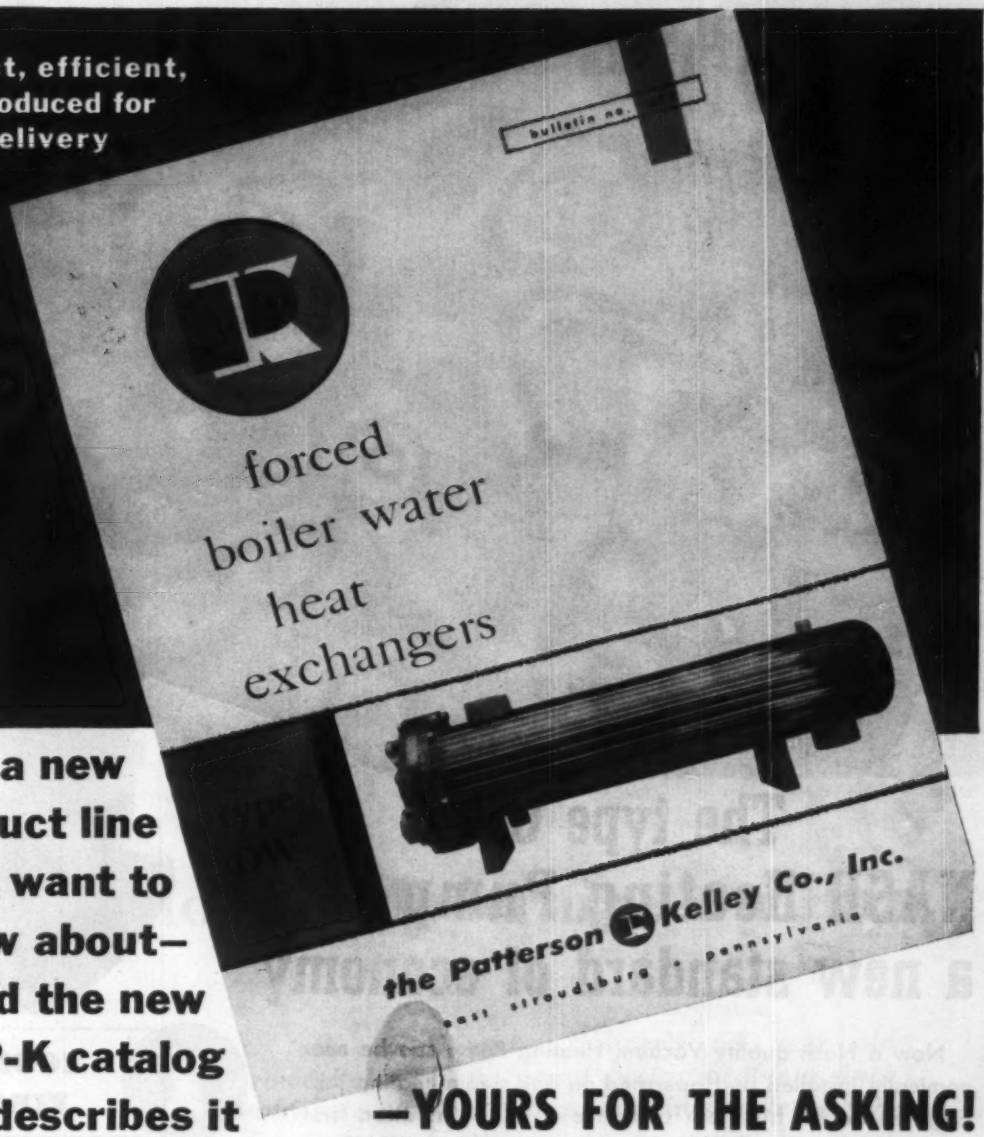

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ROOF LOAD LIMITATIONS dictated that roof could handle weight of equipment so long as it was well distributed, as shown here during installation

High Velocity System Solves Hotel's Modernization Puzzle

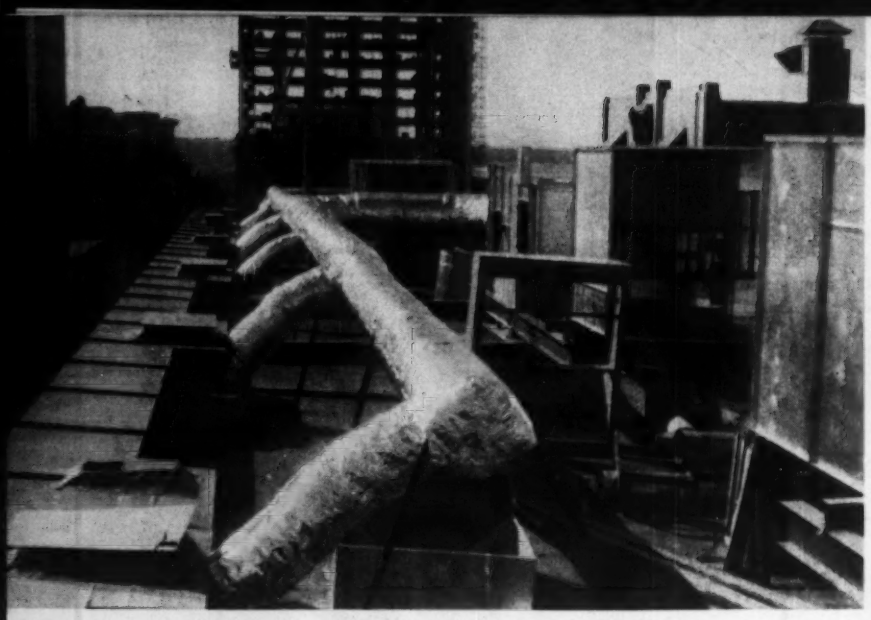
Air conditioning Denver's 65 year old Brown Palace Hotel posed vexing problem since building's original plans were incomplete. Survey uncovered walled-over fireplaces in guest rooms, several pipe chaseways extending from floor to roof, abandoned elevator shaft; and also set roof load limitations for equipment—all leading to decision to install high velocity induction reheat system.

BY THOMAS GRESSETT
Rollins & Stone, Inc.
Consulting Engineers

THE Brown Palace Hotel has been a Denver landmark since 1893. The triangular shaped structure is one of the first multistory structures of its size to be constructed in that city.

Our firm was engaged by the hotel to design an air conditioning system for this building as well as design a central refrigeration plant to be capable of generating chilled water for both the old nine-story Brown Palace Hotel and the new 19-story Brown Palace Hotel West, which is presently being constructed directly across the street.

The original plans were in such poor condition that they were virtually useless. So many unrecorded revisions had been made to the original building structure that our job began with a complete archi-



HIGH VELOCITY AIR DUCTS branch from headers to supply 70,000 cfm of conditioned outdoor air to building via fireplace tile flues

tectural survey which necessarily included a structural analysis.

This analysis revealed that there were specific roof load limitations. The roof could handle the weight of the required air handling units as well as a cooling tower so long as these loads were reasonably distributed.

Our architectural inspection also clearly pointed out that the original building contained a fireplace in each room as well as several pipe chaseways which extended from the basement all the way through the structure to the roof. All of the rooms face the outside on each of the three sides of the building and a central rotunda extends from the first floor to the ninth floor.

Coincident with the installation of the central air conditioning system, the entire basement area which serves as a kitchen and food preparation area had to be remodeled to accommodate enough kitchen space for both the existing hotel and the new 19-story structure across the street.

The eighth and ninth floors are used exclusively as permanent residences. These two floors were air conditioned in 1936. This system comprised a 40 hp compressor and an air handling unit located in an equipment room on the roof. Conditioned air was supplied to each room through a furred duct installed at ceiling height in the hallways of these floors. When it was decided to air condition the hotel throughout, this system was abandoned.

Use Existing Steam Piping

The building is heated by steam supplied from the Colorado Public Service Co. steam mains. Our survey showed the piping which serves this heating system to be in good condition. Selecting an air conditioning system that would utilize the existing piping, stay within structural and esthetic limitations of the building, yet include independent temperature control in each room, was at best a very difficult job.

Denver's excellent climate is advantageous in that it has a relatively low wet bulb design temperature. Taking advantage of the low wet bulb, sprays were incorporated in the air handling units to effect sensible cooling and thus reduce the total required equipment tonnage.

During the cooling cycle the return air serves to no advantage, so the conditioned air is delivered from the rooms to the basement as ventilation air and then exhausted to the atmosphere.

While introducing 100 percent outdoor air during the heating cycle wastes part of the heat energy imparted to the air, this cost is largely offset by low cost central steam as well as by the major operational savings during the cooling cycle. This plan also requires no return air duct system which would have been necessarily costly to install and offer little advantage.

Again, with the excellent climate conditions, considerably larger volumes of outdoor air can be used so that the refrigeration equipment does not have to operate when the ambient air temperature is below 52 F.

Ducts Fit Fireplace Tile Flues

Our problem was to find a place to introduce 70,000 cfm of outdoor air to the building. The possible use of fan window units was eliminated because of the complex wiring system required and the higher fan noise level. Finding that every room at one time had a fireplace, we discovered tile flues still remained in the old 3 ft thick walls.

A complete exploration of this old tile flue confirmed our thinking that the flue tiles were banked in groups large enough to accommodate high velocity air ducts. This became the basic criterion for the design of the entire system.

The high velocity air duct system immediately pointed to the use of induction units in each room directly under the windows. The induction units selected later proved to operate quietly and this particular noise elimination played an important part

INDUCTION UNITS are located in each room directly under windows. Air risers enter rooms through flues. Note single steam coil over unit

in the very successful overall operation of the system.

Knowing the roof load limitations, we used two air handling units to supply air to each face of the triangular shaped building. The next problem was to find a location for the mechanical refrigeration equipment. A space approximately 60 × 20 ft was found, in spite of the fact that the kitchen operations consumed virtually all the available space.

In selecting the central refrigeration equipment, dependability, flexibility, cost, and space limitations were considered. Four 150 ton reciprocating compressors were chosen. The units operate in parallel and are controlled by a pneumatic temperature control system. Since the central refrigeration plant serves two separate buildings, a central control panel was installed.

With steam risers and a vacuum condensate return system already installed in the building — and in good condition — our thought was to utilize this steam system to good advantage. Finned coils located immediately above each induction unit serve efficiently for winter heating and as reheat coils for summer cooling operations.

How System Operates

The flue locations and steam piping and equipment space requirements firmly established the high velocity induction reheat system for the hotel. The air flow for this system is as follows:

1) The outdoor air enters the air handling unit through the preheat coils (to heat outside air to 45 F for winter operation only).

2) Immediately downstream of the preheat coils, the air passes through a recirculating water spray where it is adiabatically cooled. The cooling coils further reduce the primary air temperature to the lowest temperature required by any one room.

3) The air then passes through the reheat coil (which operates only to reheat for winter heating), through the sound absorber, duct header, and riser system, and finally into the induction units in each room.

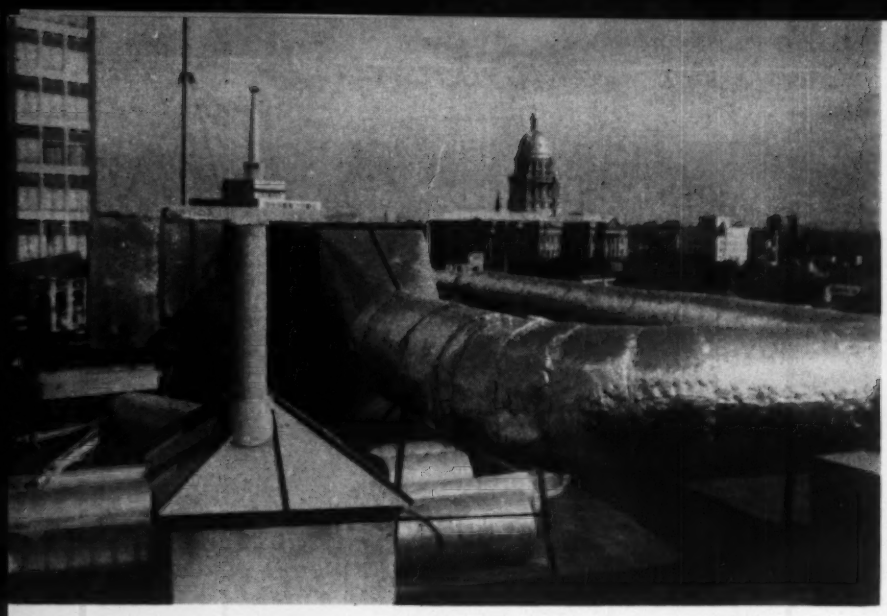
4) The induction unit nozzles induce room air to pass through a finned reheat coil. An outside solar compensator sets the required entering air temperature. However, if this particular room thermostat is set at a temperature above the entering primary air temperature a simple steam regulating valve opens and the finned steam reheat coil heats the cool air to the specific temperature desired by the occupant of any individual room. Thus, with only a simple three zone control system for the entire building, the high velocity induction reheat system has the flexibility to provide each occupant his own desired room temperature.

5) The primary air that enters the room is exhausted through grilles over the doorways and into the rotunda area directly over the lobby. At this point it acts as secondary cooling air for the lobby and is exhausted from the lobby by three large fans into the basement.

6) This same air is circulated throughout the basement for ventilation purposes. Approximately two-thirds of it is exhausted at the main cooking hood to the atmosphere through an existing exhaust chase. The remaining one-third of the air in the basement is circulated through the lavatories and locker rooms and is collected through individual duct systems and exhausted through existing pipe chases to the atmosphere.

Provide Sound Absorption

One of our major problems in dealing with high velocity air handling units was sound generation from the fan and high velocity air passing around excessively sharp bends in the air ducts. After an extensive research study in the field of sound isolation, we selected a sound absorption unit which would provide sound absorption over the entire frequency range of fan noises, and which would fit into the available space.



MAJOR PROBLEM was sound generation from fans and high velocity of air in ducts that could not be streamlined because of space limitations. Solution was found in sound absorption unit which would fit available space, shown here connected to header

The high velocity duct system was designed by the static regain method to avoid even the slightest miscalculation in duct sizes since the air is traveling through these ducts at a maximum velocity of 4000 fpm. Considerable care was exercised to make sure that the static pressure upstream of each riser take-off was the same. This same static regain design procedure was followed for induction unit take-offs. Therefore each induction unit was designed to have the same static pressure as the discharge nozzles throughout any one zone.

The main header air distribution system was extended at each end to include the first riser of the adjacent side of the building. This procedure permitted corner rooms to be controlled on a single zone, thus eliminating "fighting" between two induction units controlled on separate zones in the same corner room.

Run Piping Via Elevator Shaft

By utilizing an abandoned elevator shaft the chilled water piping was readily run from the refrigeration equipment in the basement to the roof and then piped through a reverse return piping system to each of the six air handling units on the roof. Condenser water piping was also run in this same abandoned elevator shaft to the cooling tower and back to the refrigerant condensers in 10 in. steel lines.

Each of the three faces of the building is an independent zone. As stated earlier, conditioned air is supplied by two separate air handling units on each zone. While these units operate independently they are both controlled by a single solar compensator on each zone with a manual override on the main control panel in the basement.

This lets the operator supply cooled air to the dining halls on the second floor when the cooling load of these dining halls exceeds design conditions even though the solar compensator may not be calling for cooling. Again, this points out the flexibility of control of the high velocity induction reheat system. The operator can override the solar compensators at will from his main control panel in the basement.

At the same time an occupant of any other room desiring much higher room temperatures can maintain this desired warmth by leaving the room thermostat at the temperature desired. The room thermostat will automatically energize the modulating reheat control valve at the induction reheat coil to hold the room at any desired temperature.

Obviously, the reheat system, while offering individual room control at minimum control installation expense, must reheat cool air and waste part of the energy expended in securing this primary cooling air. By the same token, reasonably accurate operation, solar compensators, and a central control panel can keep operational reheating costs to a minimum.

Design Is Guide For Other Jobs

While the design of the Brown Palace Hotel central air conditioning plant had many complexities that were peculiar to this particular building, it still had many other aspects that are typical of the problems faced in air conditioning all existing hotels. Specifically, the application of a high velocity induction reheat system, the utilization of existing steam lines, and the flexibility and simplicity of the control system are typical of the basic problems that apply to every other hotel remodeling job.

There are several thousands of existing hotels in the U. S. that will be air conditioned in the next few years. It is our desire that this article may emphasize the advantages and flexibility of the high velocity induction reheat system to those who will be involved in the design and installation of these systems.

Midwest Plumbing and Heating, Inc. was the mechanical (heating, piping, and air conditioning) contractor for this installation. Fisher, Fisher & Davis was the architect. ≠

Cooling Towers, Cold Water Piping Serve Process Cooling Applications

Keeping industrial equipment cool and operating often requires complex design. For example, in welding operations uninterrupted cooling must be provided to many points through piping that permits varying rates of flow. Calculating present and future water requirements is a major consideration, as are the type pf receiver tank used and the piping layout.

BY JAMES C. BISHOP
Plant Engineer

DUE TO the rapidly increasing use of water in industry and the increase in water costs, a definite trend exists toward the installation of cooling tower systems for industrial process cooling to reduce water consumption. This type of cooling is particularly attractive to the large volume water user. In addition to saving on water cost, it also retards internal deposits in piping and on heat exchanger surfaces, and prevents condensation on piping and equipment.

Such a system comprises a cooling tower and the piping to and from the equipment being cooled. In design, consideration must be given to the volume of water required to meet the cooling needs, and the size and arrangement of the tower and piping dictated by that volume.

Generally speaking, there are two types of towers: coil and open. In the coil type, the coolant is recirculated through a heat exchanger coil. Separate water contained in the tower basin is pumped to the top of the tower. This water is broken into small droplets and is cooled adiabatically as it falls to the coils. The cooled water bathes the heat exchanger coils, thus extracting heat from the coolant inside the coils. This type of tower has the advantage of a closed system. It also has the disadvantage of not being as efficient for cooling as an open tower. Therefore for the same cooling effect the coil type tower would have to be much larger than the open tower, particularly if it is desired to cool the coolant water to within a few degrees above the wet bulb air temperature.

In an open tower the water to be cooled is pumped directly onto the top of the tower. The water is cooled adiabatically as it cascades over the tower and is in intimate contact with the surrounding air. There is no extra heat transfer from cooling water to coolant. This kind of tower is best suited for an application where it is desirable to cool the water as much as possible.

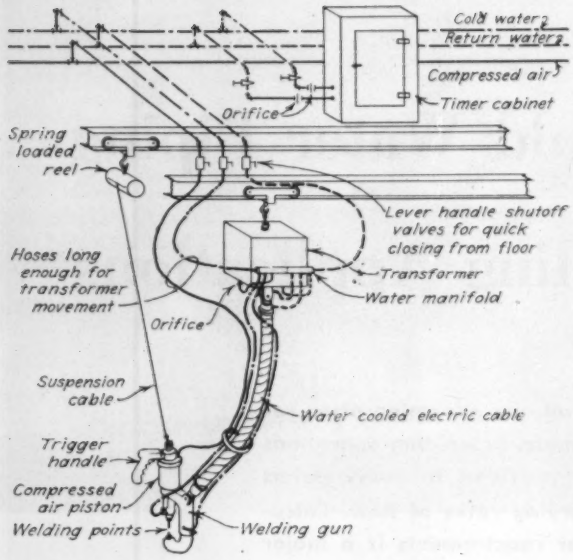
How to Design Typical System

Consider a cooling tower for a specific application such as providing constantly recirculated cooling water for welding equipment. Suppose this equipment, all of the fusion welding type, consist of 200 portable welding guns, 10 pedestal welders, and 5 press welders. Each piece of welding equipment includes its welding points and a transformer and timer. The transformer reduces the voltage and increases the amperage that flows through a water cooled conductance cable to the welding points. The timer times the current to the transformer. There are therefore four heat producing parts for each piece of welding equipment which must be cooled: points, cable, transformer, and tubes in the timer cabinet.

The best way to establish the amount of cooling water needed is to measure the flow through each typical piece of equipment. That can easily be done with a stop watch and a 1 gal can. Fig. 1 reveals that any part of the welding gun assembly can be isolated for water measurement.

The author is in charge of heating, ventilating, process piping, large scale air handling, hydraulic conveying, and other similar work in a large industrial plant. The name of the plant is withheld at company request.

Three previous articles by the author on industrial coolant systems were published in the September and October 1952 and January 1957 issues.



1 COLD WATER keeps welding points, cables, transformers, timer cabinet from getting too hot. Water is constantly circulated at flow rates according to individual needs. Flow rates are regulated by orificing. If system stopped, water would go to steam, causing welding cables to burst

Note that there are two separate supply and return connections both to the gun and to its electric current cable.

If supply water is hooked up to the gun inlet connections and the outlet from the gun is hooked to the cable water supply connections, there will be a complete parallel flow through the gun and cable. This provides a separate supply of cold water for each side of the gun. The welding points are hollow and are therefore kept cool because water goes through them first. Next, the water flows up through the cable, which is made up of many electrical conductor wires. The cable is usually divided by rubber separators. Each of the two water channels thereby created has its own water connections. The flow of cold water through these channels must be maintained at all times since any prolonged interruption would permit the high amperage wires to heat the water to steam, causing the cable to burst.

The water flow through the gun and cable at 30 psig initial pressure would be about 1.5 gpm. This will keep a fast working gun and cable from getting too warm.

The transformer has four water connections, two for inlet and two for outlet. Usually, one supply connection is hooked to the fresh water and a jumper is hooked up between the first outlet and the other supply. This will allow about 3 gpm to flow through the transformer. In very fast working guns the two supply connections of the transformer can be hooked individually to fresh water. This will provide about 6 gpm flow. In either case, each transformer circuit should be orificed down to about 1.75 gpm.

All the timer cabinets for pedestal and gun welders will use nearly 4 gpm of water if they are not orificed. They could be orificed down to about 1 gpm, but in so doing, the orifice becomes very small. A particle of iron oxide could provide enough of a barrier to stop flow, thus allowing the nitron tubes to heat up and stop the flow of electricity.

If a $\frac{1}{8}$ in. orifice at 30 psi pressure is used, there would be about 1.75 gpm flow through the timer panel at practically no temperature rise. Under this condition the chance of the orifice plugging is almost nil.

Water flow regulators are available which are adjustable to the desired flow rate. Each of these devices has two very small orifices. There is also a fixed orifice plate with a single monel orifice commercially available which can be inserted into a standard pipe union. These are custom made to specifications. The plate should be provided with 1 in. of $\frac{1}{4}$ in. copper tubing on the downstream side of the plate, so that it will not "squeal" due to rapid expansion of water.

Some of the specialty manufacturers of piping equipment publish tables showing "theoretical flow-through orifices." A plate orifice capacity may be determined by multiplying the theoretical discharge by a K factor of 0.61 to obtain actual flow.

Determine Water Requirements

In most production welding work usually less than one-quarter of the portable guns and pedestal welders will be working fast at any one time. This equipment should be connected as shown in Fig. 1. Equipment that does not work as fast can be hooked up in series. That is, water enters one side of the gun and is jumped from the outlet to the other side. At the last outlet of the gun, the water goes up through one side of the cable and back to the return line. The transformer should be hooked up separately and orificed down to 1.75 gpm. Under that hookup, the gun and cable will use about 1 gpm or less and the transformer will use 1.75 gpm.

The automatic press welders will use anywhere from 7 to 20 gpm. Assume that each uses 20 gpm. This includes flow to welding points, transformer, and timer. This type of equipment can be orificed down to 10 gpm.

Using this data it is now possible to estimate the cooling water requirements. This is calculated as follows:

200 total guns × ¼ = 50 fast working guns
Then:
50 guns × 1.5 gpm = 75 gpm
200 total guns − 50 = 150 easy working guns
Then:
150 guns × 1 gpm = 150 gpm
For transformers, there are:
210 × 1.75 gpm = 368 gpm (200 gun welders + 10 pedestal welders)
For timers:
210 × 1.75 gpm = 368 gpm
For automatic press welders:
5 × 10 gpm = 50 gpm
For pedestal welders:
10 × 1 gpm = 10 gpm

Adding the flow requirements for all these components gives a grand total of 1021 gpm required for the entire installation. This figure can be rounded to 1020 gpm for purposes of further calculation.

Design For Anticipated Expansion

Later on, the welding shop may be expanded to include more equipment. Suppose it is anticipated that the increase will be 25 percent, to include 50 more guns and a press welder. The additional 25 percent would require 255 gpm more, bringing the total to 1275 gpm. There probably will not be over four fast welding operations included in this addition, so this total can be reduced slightly. Therefore, it would be reasonable to select a commercial type cooling tower to cool 1200 gpm from 95 F to 83 F when the surrounding air temperature is at 75 F wet bulb.

The water leaving a welding transformer is usually around 105 F, although it sometimes goes to 120 F. Usually the water leaving the cable is 90 to 95 F and that leaving the timer panel does not rise much in temperature. Normally, the water temperature of the mixture does not rise over 7 F deg. It is good practice to design for a 12 F rise to provide a cushion.

The 75 F WB temperature chosen is conservative because the outside air rarely exceeds that temperature in a temperate climate. A cooling tower tries, but can never quite cool water to the wet bulb temperature. For that reason, it is not necessary to insulate the water piping against sweating.

Tower Basin Serves as Good Settling Tank

The basin, besides serving as a reservoir to keep the pump in prime, also acts as a very good settling tank. Consider, for example, a 1000 gpm tower which is 16 × 22 ft. Half of the water (500 gpm) will cascade down one side of the tower. If the water in the basin is 8 in. deep and is flowing at 500 gpm down each half of the tower, it would amount to (500 × 0.134)/60 = 1.11 cfs. Sectionally, the flow velocity would be 1.11/(8/12) 16 = 0.104 fps. This relatively slow rate would encourage good settling.

There is one qualification to a settling tank. Under certain conditions, the tower may pick up certain solids that will not wet down. In that case, a bypass filter to remove 20 percent of the recirculated water may have to be installed.

If, during freezing weather, the tower is not operated 24 hr per day, the water cannot be allowed to remain in the basin all the time. Therefore, a suitable settling basin should be provided inside the plant. This tank should be large enough to hold all drainage from the tower and return piping.

The water draining into this tank should be introduced in such a manner that it will cause the least amount of turbulence. The tank should contain no obstructions, such as baffles, that would cause a change of velocity.

Before reconnecting used welding equipment to a new system of piping, the equipment should be chemically cleaned. If the system is a large one, the water should be treated, not only to prevent algae growth, but also to keep scale forming deposits in solution until they can be blown down. To make sure the treatment is keeping the piping clean, a small section of detachable piping should be installed in the system. This sample piping can be removed and inspected at intervals.

What to Consider in Designing Piping

Now that the tower has been chosen, the next step is to decide on a piping layout. If the settling tank can be located in about the middle of the system, water can be pumped through the welders and returned by gravity. If, in that case, the main supply header is not reduced in diameter as it goes along the plant, there will be no appreciable drop in pressure near the extreme ends and each gun will be supplied at the same pressure provided there is no back pressure in the return line. If the building is so long that it is impossible to grade the return, then a reverse return system of piping should be used.

To insure against back pressure and unreasonable pipe sizes, gravity return piping should be treated as open channel flow. The inverts should be even and the pitch or grade should be constant. A recognized flow formula such as Manning's or Kutter's should be used in designing the system. Careful attention should be paid to venting, since improper venting can cause uneven flow, with belching at the end of the line.

Consider a return line 500 ft long with a slope of ⅛ in. per ft. The difference in elevation from one end of the pipe to the other would be about 62 in. This is possible because in most roof trusses there is a panel where it is possible to get such a slope. If there is interference from cross piping, it is best to offset this interference if it is at all possible.

An offset in the gravity return line can be provided as a last resort. The offset should not be abrupt, but made laterally at 30 deg. In an extreme case, a pocket can be made in the return line similar to a door loop in a steam line. The top half of the loop need only be large enough

to carry the air. The bottom of the loop should be provided with drainage and cleanout facilities.

In general, it is best to run plant piping close to column lines since it makes the plant look more orderly, sometimes helps when moving machinery, and makes it is easier to trace out the piping.

From the estimate of the water quantities involved, a flow of 1200 gpm or $(1200 \times 0.134)/60 = 2.7$ cfs is required.

For the design of the return piping system, assume the layout of the major cooling components indicates that a gravity return system is less costly than a reverse return system. To design the return, Manning's formula will be used. This formula is:

$$V = (1.486/n)(r)^{2/3}(s)^{1/2}$$

Where

V = velocity, fps

r = hydraulic radius of the wetted cross section of the pipe divided by the wet circumference of the pipe, ft. r is always one-quarter of the inside diameter of the pipe if it is running full or half full. Therefore V is the same in either case, also

n = empirical value for the roughness characteristics inside of the pipe that is in contact with the water. This value may vary from 0.010 to 0.013. In this example, assume smooth, well fabricated piping, where $n = 0.010$

s = slope of the hydraulic gradient. In this example, $s = \frac{1}{8}$ in. per ft, or 0.01 in. per ft.

Experience indicates that a 10 in. pipe will handle the 1200 gpm, or a flow rate of 2.7 cfs. Substituting in the Manning formula gives:

$$V = (1.486/0.010)(10/4 \times 12)^{2/3}(0.010)^{1/2}$$
$$= 148 \times 0.35 \times 0.10$$
$$= 5.2 \text{ fps.}$$

Therefore the 10 in. pipe is a good selection for two reasons. The area of a 10 in. pipe = 0.545 sq ft, and 0.545×5.2 fps = 2.83 cfs which exceeds the required 2.7 cfs. This indicates that the pipe will flow more than one-half full but less than full.

Velocities over 3 fps but less than critical are desirable in drainage work because there is less tendency for settlement of any solids in the pipe. The critical point occurs where the flow conditions change from laminar to turbulent. This occurs at velocities over 9 fps in general. It is always desirable to select the pipe size that will permit the pipe to convey the water over one-half full.

For instance, along the return line where the flow rate is 600 gpm or 1.34 cfs, an 8 in. pipe would probably be sufficient. Substituting in the Manning formula:

$$V = (1.486/0.010)\ (8/4 \times 12)^{2/3} \times (0.010)^{1/2}$$
$$= 148 \times 0.303 \times 0.10$$
$$= 4.46 \text{ fps}$$

The area of an 8 in. pipe = 0.349 sq ft, and $0.349 \times 4.46 = 1.56$ cfs which is more than adequate. At one-half full the flow rate would be 0.78 cfs. Therefore the pipe would be over one-half full and the velocity would be about 5 fps.

For the pressure piping at the branches it is not necessary to use a value of $C = 100$ in the Williams and Hazen formula. This would be a very nearly closed system and would not be subject to much internal corrosion. In fact, with intelligent water treatment there would be no internal deposit. Therefore a value of $C = 130$ may be used. To do this the piping tables that are based on $C = 100$ can be modified by 0.62. The pressure drop through the gun and cable will probably be 20 to 23 psi, so the total head against the pump will be elevation, friction of longest supply, and pressure drop through the welder. The return piping does not affect the pressure drop unless it is nongravity.

Make Sure Indoor Tank Is Large Enough

If it is decided to put settling tanks in the plant instead of having water in the basin of the tower, these tanks should have enough volume to hold all the water that will drain back from the tower and drain piping, plus have a safe working level. The tower manufacturer will provide information on how much water is on the tower. The amount of water in the piping can be closely approximated by figuring all the return piping as being half full.

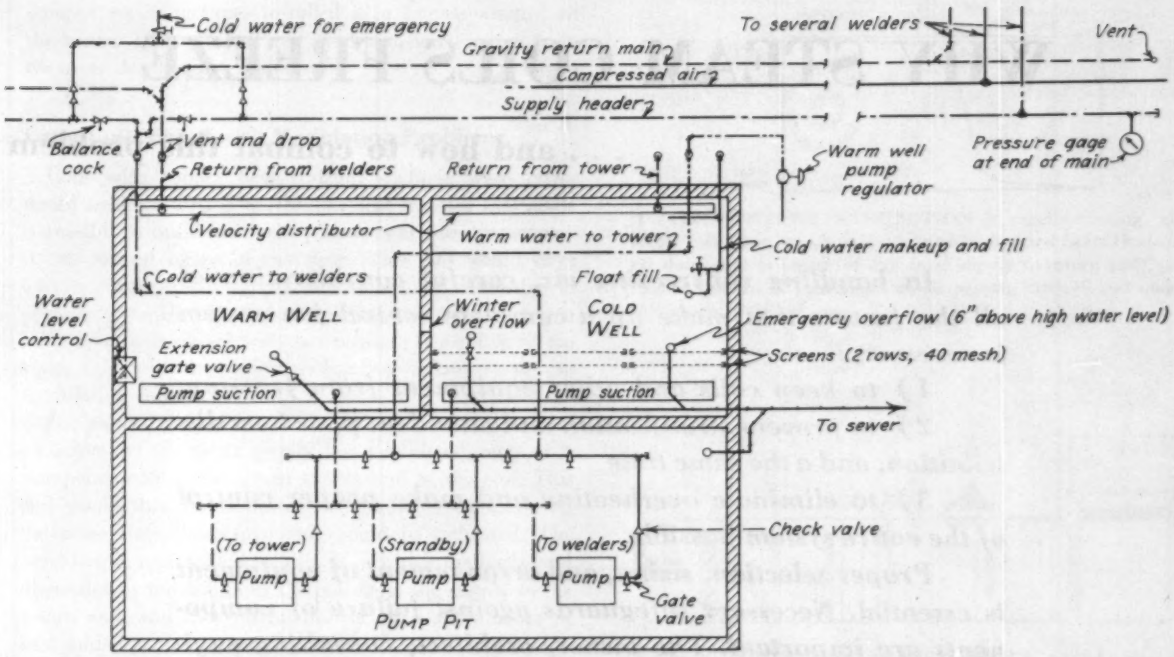
In a long system there will be some lag between the time pumps are started and the time water starts to return. During this interval, the water must not drop so far that the pump loses its prime.

Two wells serve as receiver tanks, as shown in Fig. 2. The advantage of having two wells is that there is no mixing of warm and cooled water. The water that is pumped to the welders is at the temperature it leaves the tower. The well also acts as a settling tank, provided the velocity across the tank is low enough. The tank is usually built with a dividing partition and an overflow at the working water line so that when the weather is too cold to pump water to the tower, the water will spill over from one well to another.

There are three pumps, the center one being a standby. The pump piping can be designed so that the frictional resistance is much the same for each pump. If the pump discharge from the center pump ends up bull-headed, then the end pumps should be piped the same way. Each pump should have its own pressure gage connected close to the pump discharge flange. Reference to the pressure gage and the pump performance curve will tell about how much water is being handled.

There should also be temperature gages with remote bulbs immersed in the suction line from each well to give water temperatures both to and from the welders. Another item to install is a water level regulator on the warm well pump discharge. The cold well will operate at the same level because most of the water pumped out of the warm one will return from the tower to the cold well. Also, when the warm well has been pumped down to the normal operating level, the regulating valve will start to close. In the morning the warm well pump should be started first. After the water has started to return from the tower the cold well pump can be started.

As stated before, the amount the water will drop when the pumps are started can be calculated. However, if space limitations will not permit as large a settling



2 WARM, COLD WELLS serve as both receiver and settling tanks. Water is pumped to welders at temperature it leaves tower. When water temperature drops to 40 F, warm well pump stops, permitting warm well water level to rise and spill over into cold well

tank as would be desired, the location of the overflow opening becomes critical. In such a situation about all that can be done is to fill the tanks to what is thought to be a reasonable level and start up the warm well pump. As soon as water starts to return from the tower, the pump liquid regulator control can be set to close the pump discharge regulating valve. This will be the minimum low working level. The next step would be to cut a rectangular opening 2 in. above this level for water overflow.

The pump suctions should be 6 in. above the floor of the settling basins. A distributing box should be provided so that entrance velocities will be low and distributed evenly. This would be, in effect, a diffuser operating in reverse. The same reasoning would apply as in designing a diffuser for handling air. It can be made out of heavy sheet metal.

The diffuser for the water returned from the tower or welders can be a large horizontal pipe located about 2 in. above the normal water line. The bottom one-third of this pipe can be drilled with 1 in. diam holes, which are staggered for minimum disturbance to the water in the basin.

Provide Control to Meet Weather Changes

In designing a control system for the installation, the cooling tower fan and the pump motor controls should all be equipped with indicating lights. Temperature gages and liquid level indicators can all be mounted on the same panel, with tubes going to the immersion bulbs.

The fan can run at full speed when the water off the tower is above 70 F. It can run at reduced speed between 60 and 70 F and should stop when the water is reduced to 60 F. If the water temperature should drop to 40 F the warm well pump should stop. This will immediately permit the water level to rise in the warm well and flow through the overflow opening in the water well partition into the cold well. When the pump stops, a bypass valve should open to drain any outside piping into the return. To prevent the warm well pump from cycling, a time delay device should be incorporated.

It is recommended that the tower be thoroughly washed down and operated for about a week before making connections to the welding equipment. This precaution cannot be over emphasized. A new tower has some tendency to release small particles of wood into the water at first. This annoyance would never be noticed on compressor cooling, but in the case of water cooled welder cables care should be taken to remove all particles of sawdust.

Most particles settle in less than four minutes and some will never settle. When the designer of a cooling tower system is forced to install inside water storage tanks, he probably will never have serious trouble if he is particular about the following three points:

1) Clean up everything and wash down the new tower
2) Provide good settling and screening
3) Furnish reliable water treatment. ∓

WHY STEAM COILS FREEZE

. . . and how to combat this problem

In handling subfreezing air, careful consideration of all the factors that make up a complete central fan system is necessary:

1) to keep coils and other equipment from freezing,

2) to prevent stratification and attendant poor heat distribution, and a the same time

3) to eliminate overheating and make proper control of the entire system possible.

Proper selection, sizing, and arrangement of equipment is essential. Necessary safeguards against failure of components are important. The owner, architect, consulting engineer, equipment manufacturer, installing contractor, and operating personnel all share in the responsibility. Their coordinated efforts are necessary if satisfactory performance is to be achieved.

BY H. W. ALYEA
Chief Field Engineer
Johnson Service Co.

STEAM COILS have been frozen often enough to justify a general discussion of the subject. Perhaps it is fitting that the discussion be presented by someone from the control industry, since we are often the ones at whom the finger of blame is first pointed. While it will not be denied that improperly applied or malfunctioning controls may cause their share of frozen coils, nevertheless there are many other factors that can also result in this unfortunate circumstance.

There is probably no way of guaranteeing that a preheat coil will not freeze. Failure of mechanical devices, improper attention by operating personnel, or tampering by unauthorized persons can thwart the best of plans. This article will discuss a number of the most common causes of freezing and some of the successful methods of eliminating these causes.

Besides providing adequate protection to coils subjected to freezing temperatures, other requirements must be considered:

1) Overheating due to operation in mild freezing weather should be avoided.

2) The leaving temperature must be high enough to prevent freezing of water coils, sprays, etc. downstream.

3) Stratification should be eliminated as much as possible, because it can result in freezing conditions in the cooler layers even when the average temperature is adequate, and also because such stratification can continue throughout the system to upset even distribution of heat.

Early Coils Had Little Danger of Freezing

When pipe coils and the later type of cast iron coils were first used in fan systems they were supplied in small units because of their weight and for the purpose of obtaining step control of heating. Each "bank" or unit would raise the temperature a calculated number of degrees and the steam supply to each bank was kept fully on or off as necessary to provide the desired temperature. There was little danger of freezing with the steam either on or off as long as the traps were functioning properly and condensate did not accumulate in the coil.

Control was often provided by a multiple-step thermostat ahead of the coils in the outdoor air stream. This furnished two-position operation of the valves on the individual coils in sequence. In some cases the outdoor thermostat controlled only a sufficient number of banks to heat the air to a point above freezing. The remaining banks were controlled in steps by another thermostat downstream.

This step operation resulted in undesirable fluctuations in the leaving temperature. For improved results a

damper was sometimes installed in a bypass around all the banks. This was operated by proportional action from the same downstream thermostat.

Later Coils Faced with Modulation Problem

Coils with copper heat transfer surfaces were introduced in the 1920's. Their higher heat transfer rate made it possible to build one bank with as much heating capacity as several banks of cast iron. This coil would have only a single steam supply and thus only one valve to control its entire capacity. Operating this valve between fully open and closed with two-position control gave too wide a temperature swing and it was necessary to use modulating control.

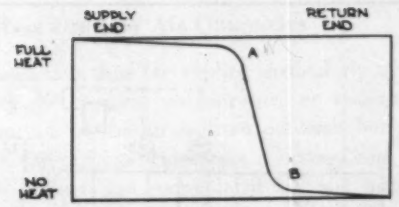
For many types of installations this introduced a complication. As the steam supply was modulated, most of it was condensed at the steam supply end of the coil. This end would then be as hot as with a full open valve. At the same time the return end would be unheated. The condition is represented by Fig. 1, in which the horizontal dimension is the length of the coil from the supply to the return end, and the vertical dimension is the amount of heat added to the air passing through the coil under conditions of full steam pressure. A reduced amount of steam can maintain essentially full pressure for a certain distance from the supply end, as indicated by point *A*. From *A* to *B* the pressure decreases rapidly and beyond *B* practically no heat at all is added to the air. While full steam pressure is supplied, points *A* and *B* are both at the return end, but modulation moves them toward the supply end.

To illustrate that modulation could not be applied to such a coil for outside air, assume a case where a coil has been selected to protect against zero weather and it is desired to have the minimum of overheating from it. The minimum temperature rise would be 35 or 40 F deg to be safe. In 25 F weather with full heat, the air would be raised to about 60 F. If a final leaving temperature of 40 F were wanted, the steam supply would have to be reduced and the result would be as shown in Fig. 1. The 25 F unheated air at the return end could freeze the condensate and possibly cause further trouble downstream from the coil.

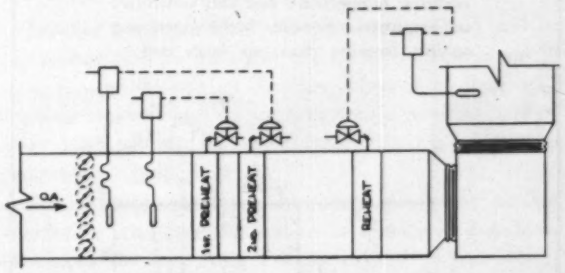
To prevent this, many such coils were turned full on by an outdoor thermostat at 35 F. This would produce a final temperature of at least 70 F and, as it was not always possible to get a coil to fit the exact minimum rise needed, this theoretical 70 F often turned out to be 75 F or more. Overheating at certain times was the inevitable result.

Distributing Tube Coil Keeps Heat Uniform

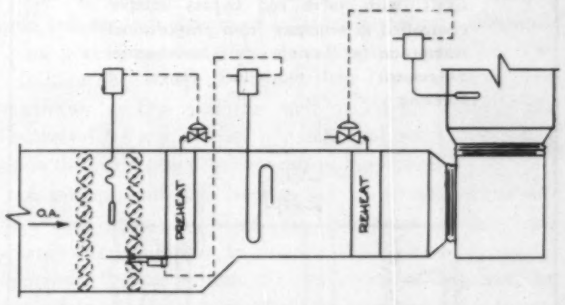
Because of the difficulty and danger of modulating such a coil, and the overheating which resulted when it was not modulated, coil manufacturers developed what is generally known as the distributing tube coil. This has a tube within a tube. Steam is supplied to the inner tube



1 TEMPERATURE DISTRIBUTION in nondistributing tube steam coil when supply is modulated is depicted here. Horizontal dimension is length of coil from supply to return end; vertical is amount of heat added to air passing through coil under full steam pressure



2 NONDISTRIBUTING PREHEAT COILS, two or more in series, are used in sequence as outdoor temperature varies. One large coil would cause overheating during mild weather

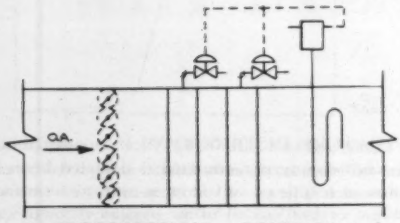


3 PROPORTIONAL CONTROL of nondistributing steam coils can be obtained with face and bypass dampers. Outdoor air temperature actuates coil valve. Dampers are controlled by proportional thermostat on leaving side

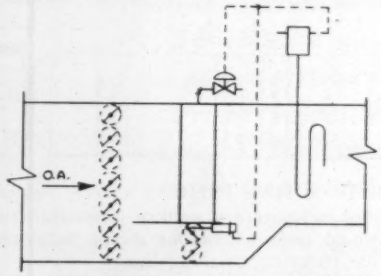
and passed through carefully sized orifices into the outer tube. This improves distribution within the tube and greatly reduces the danger of freezing, since it keeps the temperatures relatively uniform across the entire coil area.

However, even such coils as these have their limitations. When a coil is supplied with a very low percentage of its full steam capacity, the abnormally low pressure difference across the orifices makes it difficult to maintain the ideal uniformity of distribution.

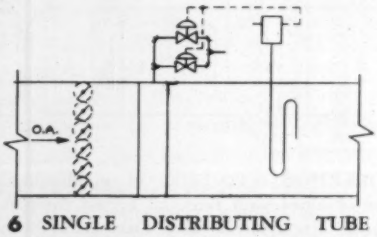
Some distributing tube coils are constructed with supply and return connections at the same end. Installing such a coil with the tubes vertical and the supply and return connections at the bottom represents the best arrangement so far as freeze prevention is concerned. The



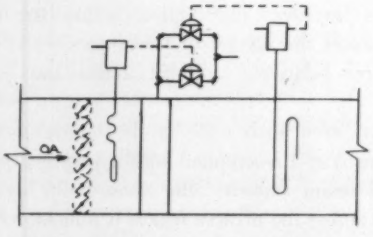
4 PROPORTIONAL CONTROL of distributing tube coil with two preheat coils, each providing one-half of required temperature rise and controlled in sequence, provide better insurance against freezing than one large coil



5 DISTRIBUTING TUBE PREHEAT COIL with valve and bypass damper controlled in sequence from proportional thermostat on leaving side is another arrangement used to reduce danger of freezing



6 SINGLE DISTRIBUTING TUBE COIL with two valves controlled in sequence provides smooth control during light load periods



7 TWO VALVES, one actuated by outdoor air temperature and the other modulated by leaving temperature, provide additional insurance against freezing

condensate falls readily to the bottom of the coil. If not eliminated immediately it is kept warm by the incoming steam even if only a small amount is being admitted.

Another design consists of supplying the steam from one end of the coil and returning it by a return bend through an adjacent tube to the same end of the coil. The two tubes have a common extended surface and the rapid heat conduction through it tends to provide approximately uniform temperature across both. The coil face is made up of these units in multiple.

Coils with such provision for giving maximum uniformity of temperature are generally specified as the nonfreeze type. Their development has been one of the important steps in reducing freezing trouble.

Controlling Nondistributing Tube Coils

Coils without distributing tubes or other means of providing good heat distribution are not generally recommended for use as preheaters. If they are used, the coil should be turned fully on by the time the outdoor temperature has dropped to 35 F. Sometimes this is accomplished by a two-position thermostat. But a preferred method, because it reduces the thermal shock to the system, is to use a proportional thermostat so adjusted as to start opening the valve at 40 or 45 F and to have it wide open at 35 F.

In very cold localities this results in overheating in mild weather because the coil must be large enough to assure above freezing leaving temperature in the coldest weather. Two or more preheat coils in series should then be used—these coils being operated in sequence as the outdoor temperature decreases, as shown in Fig. 2.

For example, if the fan system, including preheaters and a final reheater, is to be capable of providing a minimum delivered air temperature of 65 F, the first preheat coil could have a 30 F rise and would come on at 35 F outdoors. A second similar coil, downstream from the first, would be turned on at 5 F and would take care of conditions down to −25 F outdoors. For still lower outdoor design temperatures a third preheat coil might be required. Final delivered air temperature of the system would be obtained by proportional control of the reheat coil.

Proportional control of the leaving air temperature of nondistributing tube coils can be obtained with face and bypass dampers, as shown in Fig. 3. The coil is turned on from an outdoor thermostat at 35 F as before, and the dampers are controlled by a proportional thermostat on the leaving side. This thermostat should be sufficiently far downstream to provide a good air mixture, or it should have a long averaging bulb located across both the coil face and the bypass.

Controlling Distributing Tube Coils

Because two-position operation of preheat coils results in temperature fluctuations that make stable control of the final delivered air temperature difficult, most present

day preheat coils are of the distributing tube or non-freeze type which permit proportional control under most conditions without undue danger of freezing. Since such coils provide good distribution except at extremely light loads, a proportional thermostat on the leaving side, set for 50 F or higher, will have the valve sufficiently open by the time the outdoor temperature reaches 32 F so that freezing should not occur.

The greater the heating capacity of a coil, the smaller will be the percentage amount of steam needed for a small temperature rise. A coil is less able to provide uniform temperature distribution across its face and therefore is more likely to freeze when the steam supplied to it is only a small percentage of its maximum capacity. Consequently, in very cold areas two preheat coils, as shown in Fig. 4, each producing one-half of the required temperature rise and controlled in sequence, will provide better insurance against freezing than one large coil.

Even when distributing tube coils are used, face and bypass dampers or a bypass damper alone are sometimes employed to reduce the danger of freezing. Fig. 5 shows this arrangement. Both the coil valve and the dampers are controlled in sequence from a proportional thermostat downstream—the valve opening first and then the bypass closing. For any given heating requirement the valve can be wider open than when dampers are not employed, since part of the air can bypass the coil.

Parallel Control Valves Serve Single Coil

In some cases, particularly when large quantities of steam are required, it is desirable to use two control valves in parallel on a single coil. One of these should be sized for about one-third of the total capacity and the other for the remainder. These valves are controlled in sequence so that the small one operates during periods of light loads and remains open while the larger one handles the heavier demands. This arrangement, shown in Fig. 6, provides smoother control during periods of light loads when control is most difficult.

Two valves in parallel are also sometimes used on a single preheat coil to provide additional insurance against freezing. Fig. 7 shows one valve controlled from a two-position outdoor thermostat and the other controlled from a proportional thermostat on the leaving side. The valve controlled from outdoor temperature is sized to supply sufficient steam to assure good distribution across the coil. This makes a large coil simulate the action of two coils in series with the first one controlled from outdoors. This arrangement is particularly useful in improving conditions on existing jobs. It is not as satisfactory as two separate coils because too much depends on proper sizing of the valve and on the correct steam pressure. An increase in steam pressure to the valve can cause more overheating than with a separate coil because the over supply of steam is being fed into a coil with greater capacity to condense it.

Controlling Outdoor Air Quantities

The discussion thus far applies particularly to systems employing 100 percent outdoor air, or systems where only a portion of the air is from outdoors but must be preheated for various reasons. In many systems employing both outdoor and recirculated air, the quantity of outdoor air is small enough so that even in the coldest weather the outdoor and recirculated air mixture is above freezing and preheaters may not be required. If the mixture temperature is below freezing, the preheater may be located downstream from the mixing chamber rather than in the outdoor air intake. It will thus be subjected to considerably less severe conditions.

Another good practice is to place the preheat coil in the recirculated air duct and control it from a thermostat in or beyond the mixing chamber. There is no danger of freezing the coil and, if stratification is avoided, equipment downstream from the mixing chamber is adequately protected.

Many systems employ a minimum of outdoor air for ventilation whenever the system is operating, and have provisions for increasing this up to 100 percent whenever cooling is required and the outdoor air is sufficiently cool to be useful for this purpose. Such a system requires automatic dampers in both the outdoor air and recirculated air connections.

One arrangement is to divide the outdoor air damper into two sections, one sized to provide the required minimum percentage and the other for the remainder. The minimum section opens whenever the fan is running. The maximum section and the recirculated air damper are controlled in any one of a number of ways depending upon the particular requirements of the system.

A preheat coil may be installed in the minimum outdoor air opening. When the minimum outdoor air quantity is insufficient to provide the amount of cooling demanded by the system, the maximum damper may be opened in subfreezing weather. In such cases a separate preheat coil is required in this opening or else a safety thermostat should keep the maximum damper closed when the weather is below 32 F. These preheat coils should be controlled by the methods previously discussed.

Another common arrangement for providing a minimum quantity of outdoor air uses only one damper over the entire outdoor air opening, with the controls arranged to hold it in a minimum open position whenever the fan runs and to vary the position from minimum to maximum as cooling demands require. This has the advantage of allowing an adjustment of the minimum quantity, but requires a preheat coil over the entire opening, thus making freeze prevention more difficult.

Other important factors in combatting the problem of freezing pipe coils—such as supply and return piping, application and sizing of traps, use of vacuum breakers in condensate removal, designing for equal steam distribution at adequate pressure, added controls, and the various means to prevent stratification—will be described in an early issue. ≠

Success of Underground Structures Depends on Air Conditioning

Through air conditioning man can now live and work comfortably underground. Systems are designed on single year 'round temperature. Spaces must usually be preheated prior to occupancy, however. Evaluating the cooling load requires careful calculation to derive the total heat to be removed from rock surfaces, ventilation air, occupancy, and machinery.

BY THOMAS H. URDAHL
Consulting Engineer

TODAY storage warehouses and factories can be constructed underground and made just as comfortable as surface structures. Their use as personnel shelters against possible atomic attack makes them very practical and also makes their design an extremely interesting subject.

Experience developed from varied occupancies in underground structures has indicated that human reactions, tolerances, and desires are no different than those encountered in the windowless above ground structure. The loss of body radiated heat, however, is less in the underground structure due to constant temperatures of the surrounding structural mass.

In the past, feasibility studies of the habitability of underground structures have been treated as research problems. This article will analyze the elements of design and demonstrate that the problem can be solved with careful engineering and with the use of conventional equipment.

Design for Single Year 'Round Condition

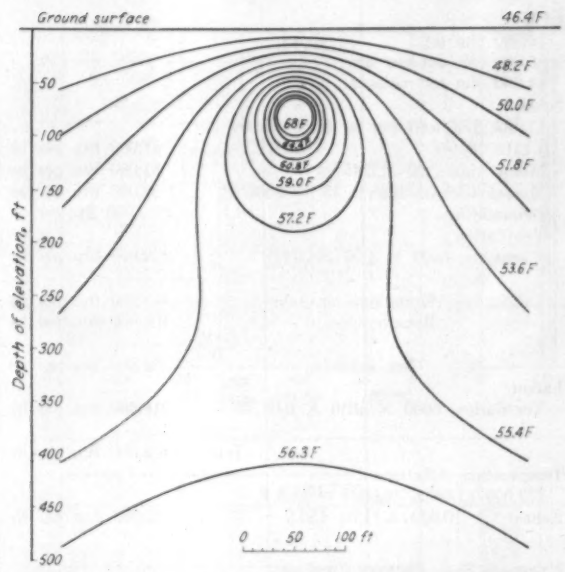
A single year 'round inside temperature is not only feasible and desirable, but economical from the standpoints of equipment capacity and operating control. A different summer and winter condition tends to complicate operation and, should surrounding rock temperatures be permitted to rise in summer conditions, say to 80 F dry bulb, an increased power consumption over a long period of time would be required to reduce the temperature to the generally accepted winter condition of 70 to 72 F DB at 40 percent relative humidity. The lower rock temperature also provides a quantity of "standby" capacity to absorb heat during casualty or emergency conditions.

This basic condition will hold for storage and for factory under a no-load condition. The design condition for a factory in full operation, to permit the equipment to perform efficiently, should be 76 F DB at 50 percent RH. The dry bulb temperature for factory conditions is permitted to fluctuate between 72 F DB at no-load condition to 76 F DB at peak load condition.

The conditions immediately sensed upon entering an underground structure or mine are coldness and high humidity. Rock temperatures remain relatively constant at various depths wherever found throughout the world. At depths of 100 to 300 ft, temperatures of 53 and 55 F prevail and are used for design purposes in preliminary calculations. The exact measured temperature of a specific installation should be applied in design and is especially significant in computing the quantity of heat to bring the surrounding structure into equilibrium with the temperature to be maintained in the occupied space.

In addition to the normal air conditioning loads — after the underground structure has been heated to the basic design condition — there is a constant quantity of moisture given to the space from the rock surface.

These factors and certain others peculiar to the underground structure must be carefully correlated in developing an optimum design condition for temperature and



1 ISOTHERMS around heated underground structure at equilibrium conditions are typically as shown above

humidity. These several primary considerations which must be simultaneously considered are:

1) Maximum protective features
2) Working comfort for occupants
3) Protection of materials and equipment
4) Heat capacity of the surrounding rock structure
5) Heat and moisture removal
6) High mechanical and electrical efficiency.

The physical and economic equation of the above results in a determination of 72 F DB and 40 percent RH as the most favorable for storage and for the basic design condition for a factory under a no-load condition.

Heating Required Prior to Occupancy

Heating is seldom required in an occupied underground structure except for the small amounts of reheat made necessary by the low temperatures needed for moisture removal in the ventilation air under storage conditions in summer and for the heat of ventilation air in winter. However, heat must be provided before initial occupancy for warming up to established design temperatures. Dehumidification should be provided simultaneously to remove excess moisture developed by condensation of outdoor air during construction. Heating may be accomplished by reverse cycle refrigeration (heat pumps incorporating dehumidification in the same system), by waste heat generators on emergency diesel power units, by vented combustion heaters, or by electric heaters. From three weeks to several months may be required to effect initial heating, depending upon the size and rock characteristics of an installation.

Coefficients of heat transfer for various rock structures are not available. One extensive test at 215 ft depth gave 1 Btu per hr per sq ft per F deg difference between rock surface and space air temperature.

The heat required to bring a new installation to basic design temperature is:

$$H_t = 1.05\ A\ td$$

where:

H_t = total Btu per hr
1.05 = roughness factor
A = total exposed rock surface, sq ft
td = temperature difference, F.

A 30-day warmup period is an economical choice. A rock surface-space air temperature difference of 4.35 F is required for a 30-day period, reducing the above formula to $H_t = 4.57\ A$. For a 22-day period $H_t = 6.3\ A$.

At equilibrium condition, there is a constant heat loss to the rock surfaces. Swedish engineering practice, apparently substantiated by experience, utilizes a coefficient of 0.66 Btu per hr per sq ft. In the absence of supporting data, this coefficient will be used in this article.

A latent heat load figure for rock surface has been obtained from experience with the steady state removal of latent heat contrasted with floor area after equilibrium was reached in one large installation. This figure of 15 grains of water per sq ft of floor area will be used in the illustrative example.

In the case of initial rock temperature, the latent heat load per sq ft of floor area should be accurately determinded for the actual installation.

Fig. 1 is a typical example of the dry bulb isotherms at one equilibrium condition.

Determine Exact Ventilation Air Quantity

Ventilation is a critical quantitative element in air conditioning of underground installations. The admitted quantity to meet design conditions must be exactly measured. For either normal or emergency operating conditions, this quantity is an important element of the cooling and dehumidifying machinery load. It likewise determines the fan power requirements when maximum filtration and purification of outdoor air is necessary.

Generally accepted concepts of ventilation of surface structures notwithstanding, comfortable odorfree conditions can be maintained with a maximum of 10 cfm per occupant. Less is required when applied through a cooling and dehumidifying system. For berthing and living spaces aboard naval surface vessels, and under crowded conditions, i.e., 150 cu ft per person, 5 cfm per person has proven quite adequate at an environmental temperature of 78 F effective temperature (85 F DB, 50 percent RH). At lower temperatures and humidities a lesser quantity may be used, i.e., 1 cfm with carbon filters.

Where chemical or gas producing processes are carried on underground, these must be separated from other parts of the installation by gastight openings and be provided with separate and independent ventilating systems. These systems should be designed in accordance with good practice for service consistent with established standards for surface installations, but with special emphasis on protective requirements and minimum power.

Vehicular passageways and power and service machinery spaces which are separated or capable of being

sealed off from personnel occupied spaces may have separate ventilation systems designed for minimum air quantities to remove gases or to limit machinery temperatures.

Outdoor air is introduced at 5 cfm per 50 sq ft for the storage condition and at 5 cfm per person for the factory condition, assuming that the occupancy is one person per 100 sq ft. This outdoor air is necessary in the storage condition, due to the possible presence of various rock gases.

Supplement Equipment to Meet Factory Load

Since the no-load factory condition is the same as the storage condition, the same problem of equipment for humidity control and outdoor air exists. With this as a basis for design, the equipment to handle the latent rock load and the outdoor air load can be supplemented to provide for the factory load. The factory load equipment is designed to handle the latent personnel load with a coil and the factory sensible load with coils and cooling panels. The use of the structure as a personnel shelter can be accomplished with the same equipment.

An underground structure can be initially designed for storage and then converted into a factory by addition of equipment, or designed as a factory originally. In either case the equipment to provide satisfactory habitability would be the same and would be commercially available. For purposes of illustration, assume the following underground area:

Structure and design characteristics:

Area:	60,000 sq ft (storage) within five interconnecting tunnels 205 ft × 65 ft × 22 ft high 120,000 sq ft (factory on two floors)
Gross volume:	1,539,035 cu ft, including 5 percent allowance for rough rock
Permeable volume:	1,245,000 cu ft gross volume, less volume displacement of structure, equipment, and people
Design conditions:	Outdoor air — summer 95 F DB, 75 F WB winter 10 F DB Storage — 72 F DB, 40 percent RH Factory — 76 F DB, 50 percent RH
Rock temperature:	72 F.

Assumed uniform load distribution:

Occupancy (factory) — one person per 100 sq ft	1200
Occupancy (shelter) —	2500

Heat loss for the space, not including ventilation air heating, if required, in cold weather, will be constant at 0.66 Btu per hr per sq ft of gross rock surface area of 282,000 sq ft, including cross connection tunnels. 186,000 Btu per hr

The following examples show how the loads can differ as the area is used for different applications:

Example 1 — Storage Cooling

Latent for rock surface: (60,000×15×1080)/7000 = 139,000 Btu

(This load is to be handled by a desiccant dehumidifier. Normal performance for a 1500 cfm desiccant dehumidifier using silica gel at 70 F, 35 percent RH is 22 lb per hr of water. Using this value as a conservative figure, a 9000 cfm double-bed equipment will accomplish this latent load removal.)

CFM:
10,000 cfm total
6,000 cfm outdoor air
4,000 cfm recirculated

Sensible:

Lights, 1/5 watt per sq ft × 60,000 × 3.1415 =	41,000 Btu per hr
Motor (fan), 20 ×2545 =	51,000 Btu per hr
Motors (dehumidifier), 15 × 2545 =	38,000 Btu per hr
Dehumidifier =	139,000 Btu per hr
Ventilation sensible, 6000 × 1.08 (95-72) =	149,000 Btu per hr
Gross sensible gain	418,000 Btu per hr
Boundry loss	186,000 Btu per hr
Net sensible	232,000 Btu per hr

Latent:

Ventilation, 6000 × 4840 × 0.00743 =	216,000 Btu per hr
Total	448,000 Btu per hr

Temperature difference:
232,000/(1.08 × 10,000) = 21.5 F
Reheat: 10,000 × 1.08 (50.5 − 47.5) = 32,000 Btu per hr

Example 2 — Factory Cooling

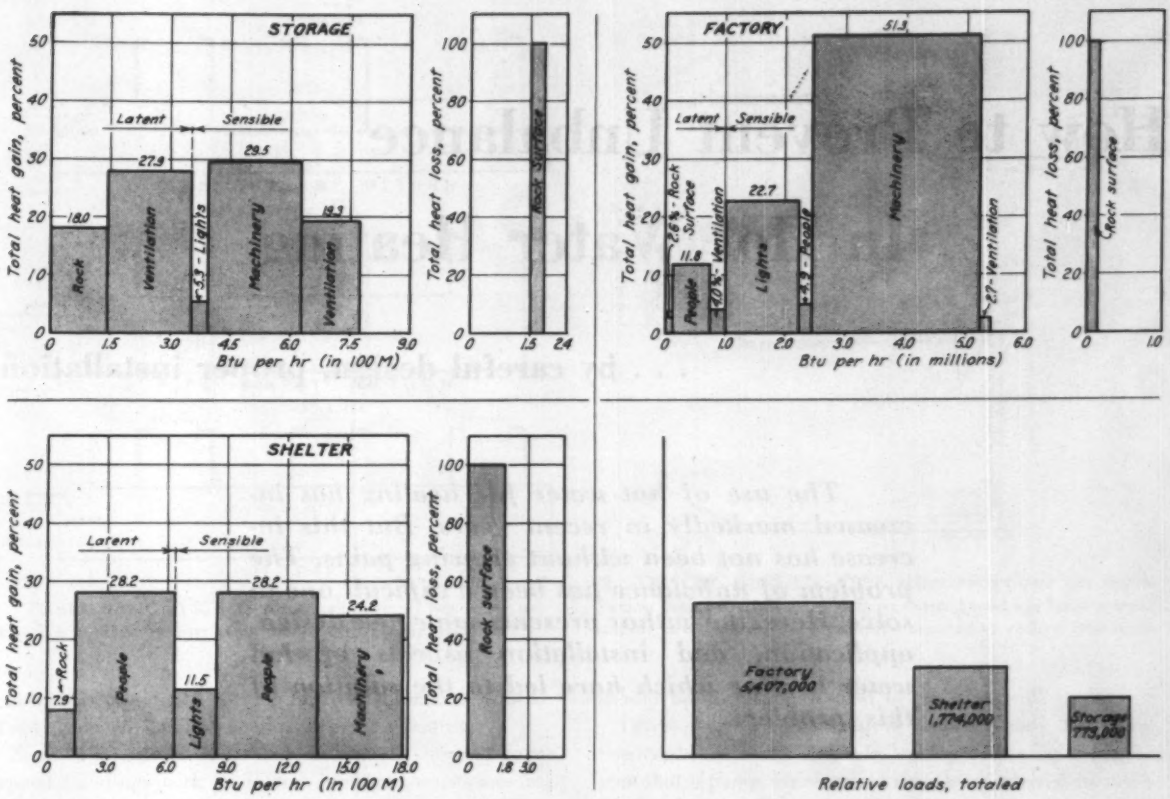
Latent for rock surface: Handled by same equipment as Example 1.
Ventilation: Sensible and latent, and storage gain (448,000 Btu per hr). Handled by storage unit equipment of Example 1.
Lights: 3 watts per sq ft (fluorescent)
360,000 × 3.415 = 1,229,000 Btu per hr
Machinery: 1 hp per 120 sq ft
1000 × 2445 = 2,545,000
Occupancy (sensible): 1200 × 220 = 264,000
Total sensible 4,038,000 Btu per hr
Occupancy (latent): 1200 × 530 = 636,000
Total gain 4,674,000 Btu per hr
Factory unit and cfm recirculated:
Q = (636,000 × 7000)/(20.5 × 4080) = 53,000 cfm
Sensible heat removed by coil:
53,000 × 28.5 × 1.08 = 1,581,000 Btu per hr
Factory cooling panels:
Sensible heat to be removed by cooling panels:
4,038,000 − 1,581,000 = 2,457,000 Btu per hr
(Under no-load factory condition, equipment for storage cooling only is in operation.)

Example 3 — Shelter Cooling

No outside ventilation — 2500 people.
Latent for rock surface: Handled by same equipment as Example 1.
Dehumidifier: 139,000 Btu per hr
Lights: ½ watt per sq ft
60,000 × 3.415 = 205,000
CO_2 absorber: 240,000
Occupancy (sensible): 2500 × 200 = 500,000
Total sensible 1,084,000 Btu per hr
Occupancy (latent): 2500 × 200 = 500,000
Total gain 1,584,000 Btu per hr
(This load to be handled by factory unit with modulation of control valve.)

Example 4 — Storage Heating

Latent for rock surface: Handled by same equipment as Example 1. This equipment will cycle on humidistat control.
Lights: 41,000 Btu per hr
Motors: 89,000
Dehumidifier: 139,000
Heat gain 269,000 Btu per hr
Heat loss 186,000
Net gain 83,000 Btu per hr



2 TOTAL HEAT GAIN in Btu per hr for same underground space compared. Note tremendous gain created by factory machinery. Heat loss is steady at 186,000 Btu per hr for all uses at inside design conditions of 72 F DB

Ventilation air heating required:

$$6000 \times 1.08 \times 82 = 531{,}000 \text{ Btu per hr}$$

(As the dehumidifier cycles, this slight excess quantity of heating will balance out, considering the net heat gain of 83,000 Btu per hr.)

Example 5 — Factory Heating

Factory unit cooling load same for summer or winter.
Storage unit to perform as in storage heating.
Under no-load condition, equipment performs as in storage heating.
Refrigeration and dehumidification machinery.

The tonnages required for cooling and dehumidification are:

Factory unit, panel cooling	389.5 tons
Storage unit	37.3
Dehumidification machinery	11.6
	438.4 tons

The refrigeration load can be handled by one 50 ton and two 200 ton units for the factory cooling load. Fig. 2 gives a graphic tabulation of the elements of heat load for the examples given.

Economics Depends on Versatility

The success or failure of any underground structure for human occupancy and use depends entirely upon air conditioning. The economics of the underground structure will depend upon its versatility of use. Initial planning must carefully consider these factors so that the same air conditioning installation can serve and protect during productive occupancy, during night or nonproductive shutdown or storage, and also as a protective shelter. This latter condition requires the consideration of many factors not mentioned here, such as constant power supply, revitalization of atmosphere — all of which are essentials, whose quantity is governed by the probable length of time that the protective shelter might be occupied.

Underground structures in rock have been usefully employed in many parts of the world. They have been generally impractical for continued utilitarian purposes due to lack of proper air conditioning except in Sweden and Switzerland where practical usage of such space has long been accomplished. The protective value was demonstrated principally by the Japanese in World War II, where despite long, continued aerial and ship bombardment, men held out and survived in underground installations until driven out by land forces. ∓

Note: Some of the values given in the examples on these pages have been taken from the psychrometric chart.

For various quantitative factors basic to heat and moisture calculations, acknowledgement is made to the Office of the Chief Engineer, Dept. of the Army; "The Air Conditioning of Swedish Underground Installations," by Henrik Conradi of "Svenska Flaktfabriken," in the December 1946 issue of "Flakten" (including Fig. 1); E. R. Queer and E. R. McLaughlin, State College, Pa.; and Axel Rosell, Stockholm, who has been principally responsible for recent refinements in the air conditioning of Swedish underground structures. (See the March 1958 Heating, Piping & Air Conditioning, pp. 118-121.)

How to Prevent Unbalance In Hot Water Heating

. . . by careful design, proper installation

The use of hot water for heating has increased markedly in recent years. But this increase has not been without growing pains. The problem of unbalance has been a difficult one to solve. Here, the author presents some new design, application, and installation aspects of hot water heating which have led to the solution of this problem.

BY T. ROBERT STEVENS
Vice President
Sarcotherm Controls, Inc.

THERE are three basic hot water heating systems:

1) Two-pipe reverse return
2) Two-pipe direct return
3) One-pipe system.

It has long been recognized that the two-pipe reverse return system has an inherent balance which is not possessed by the other two. This is because every circuit offers approximately the same frictional resistance, thus creating a hydraulic balance with equal distribution of heat.

In a two-pipe direct return system the various loops must be balanced, since water follows the path of least resistance. That is, artificial resistance must be added to equal the largest resistance offered to flow in any one circuit.

One-pipe systems must have venturi type fittings to assure flow to individual loops. Since water returned from the loops is mixed into the same supply main and theoretically its temperature in successive loops will be lower than in the first one, careful consideration must be given to limit the length of supply mains to avoid reduced heat output due to lower mean water temperatures. This problem can be minimized or eliminated by following the recommendations given in the ASHAE Guide or those of the fittings manufacturers as to maximum circuit lengths and pipe sizes. Specifically, one-pipe systems are especially well adapted to small systems or to individual loops in large systems.

Consider Adaptability for Hydraulic Balance

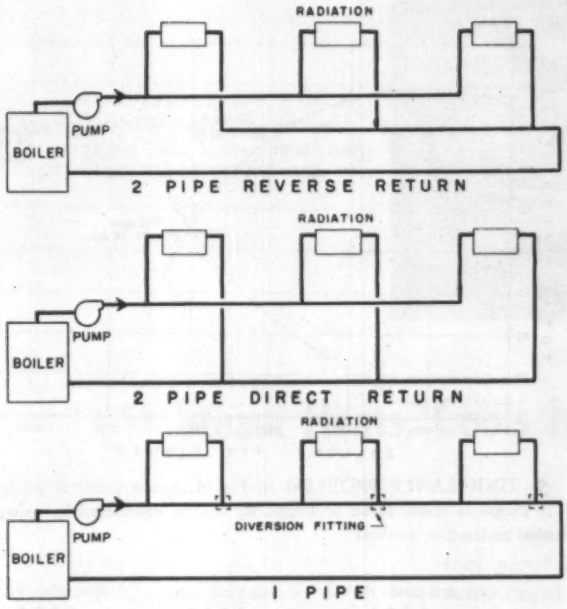
In general, whatever method of distribution is used, it is extremely important to design for hydraulic balance and consider carefully the adaptability of each arrangement for such a balance. Depending on balancing devices alone in lieu of hydraulic balance creates heat distribution (and control) problems where none would exist if the designer were to compare head losses in individual circuits and endeavor to equate them.

It might be interesting to investigate how hydraulic unbalance affects larger systems.

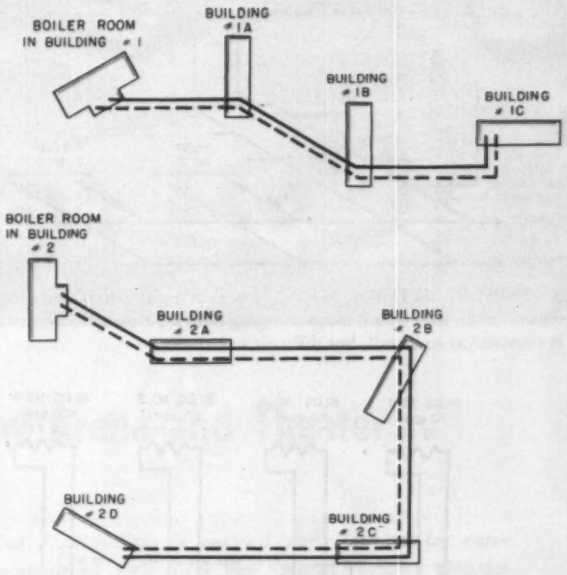
Combination System Reduces First Cost

Fig. 2 shows a typical garden type apartment project with distribution mains extending 1000 ft or more. In trying to reduce first costs of installations, many designers have resorted to combination one- and two-pipe systems. These have been prevalent in the past years.

As shown in Fig. 3, the supply and return mains form a two-pipe direct return system with individual building loops forming a one-pipe system. It is quite true that from the standpoint of first cost this is a most economical hot water system for large projects. Unfortunately, a sys-



1 THREE BASIC SYSTEMS for distribution of hot water are two-pipe reverse return, two-pipe direct return, one-pipe



2 TYPICAL GARDEN TYPE apartment project has distribution mains extending 1000 ft or more. Trend has been toward use of combination one-, two-pipe systems to reduce first costs

tem of this type has a serious inherent unbalance which, if not corrected, can and does cause erratic heating.

Such a system is illustrated in Fig. 4, showing four typical buildings with loads and frictional resistances as indicated. Here is what happens in each circuit. The main circuit pump is supposed to circulate 320 gpm against a total head of 65 ft. The first building, which has a friction loss of 10 ft, will in effect have an available pumping head of 65 ft, the second one will have 55 ft, the third one 35 ft, and the fourth 15 ft. The amount of water pumped into each circuit will be in proportion to the available pumping head in accordance with the following relationship:

Available pumping head/design friction loss = (theoretical gpm/design gpm)^2

Therefore it is obvious that, instead of pumping 70 gpm into the first building, considerably more water will be pumped because of the much larger available head. For example, substituting in the above equation:

$$65 \text{ ft}/10 \text{ ft} = (\text{theoretical gpm}/70 \text{ gpm})^2$$

or

$$\text{Theoretical gpm} = 178 \text{ gpm}$$

As shown in Table 1, theoretically, with the pumping head available across each building, a total of 592 gpm should be circulated instead of the design 320 gpm.

Obviously, if the pump were properly sized this situation could not occur since, in looking at Fig. 5, it can be seen that a pump which might have been selected for such an installation will not be able to pump 592 gpm at 65 ft head. It will, however, pump in excess of 320 gpm at a reduced head.

What the actual capacity and head will be can be calculated by a method of trial and error, as prescribed in the article, *Unbalanced System Impairs Pump Operation*, by H. A. Lockhart and Louis Oosten, in the September 1952 issue of Heating, Piping & Air Conditioning. In this case it can be established that the system will operate at 400 gpm against a 45 ft head. Obviously, this will mean a reduced flow at a reduced head in the last building, causing insufficient heat output unless balancing is done to force less water into first three buildings.

Balancing is often not a simple matter. For example, in many installations the pump can be seriously oversized. Or, a pump with a flat characteristic may pump 592 gpm at very close to 65 ft head. In this case buildings 1 and 2 might have to be throttled to almost no flow to obtain the required flow in buildings 3 and 4.

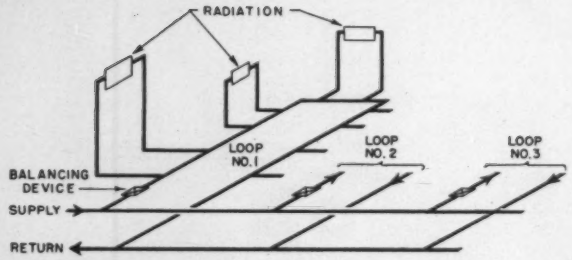
Inasmuch as each pump is individually selected for a particular installation, successful balancing of a large system often requires knowledge of design friction loss as well as available pumping head at points in the system so that the proper starting point can be determined to be followed through by method of trial and error.

TABLE 1—FOR INSTALLATION in Fig. 4, theoretically, with pumping head across each building, 592 gpm would be circulated instead of 320 gpm

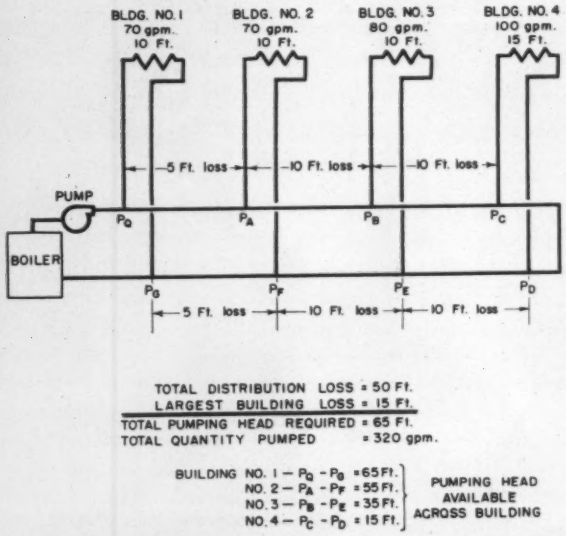
	DESIGN HEAD AVAILABLE	THEORETICAL HEAD AVAILABLE	ACTUAL HEAD	DESIGN gpm	THEORETICAL gpm	ACTUAL gpm
BUILDING NO. 1	10. Ft.	65 Ft.	30 Ft.	70	178	121
BUILDING NO. 2	10 Ft.	55 Ft.	24.8 Ft.	70	164	111
BUILDING NO. 3	10 Ft.	35 Ft.	12.5 Ft.	80	150	101
BUILDING NO. 4	15 Ft.	15 Ft.	6.8 Ft.	100	100	67
				320 gpm	592 gpm	400 gpm

In-the-Field Balancing Is Often Difficult

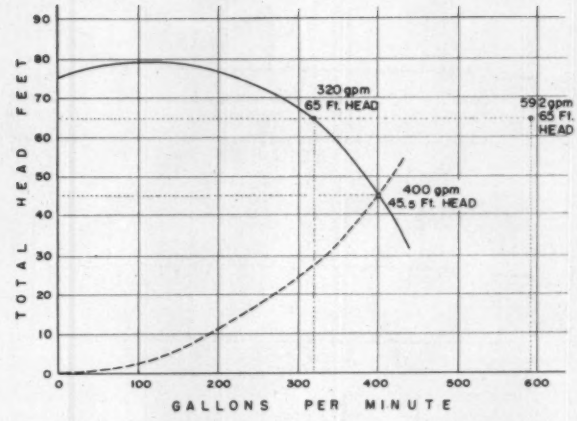
An installing contractor is not always in a position to make such detailed calculations and at times the trial and



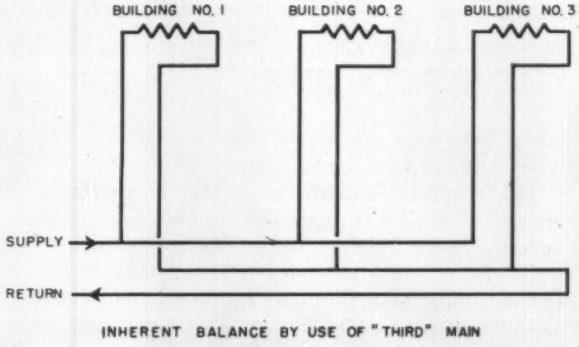
3 SUPPLY, RETURN MAINS form two-pipe direct return system with individual loops forming one-pipe system. System is economical to install, but difficult to balance



4 TYPICAL FOUR BUILDING installation served by single boiler plant has serious inherent unbalance caused by unequal friction loss. Result is erratic heating



5 UNBALANCE PROBLEM in Fig. 4 cannot occur if pump is properly sized. Head and capacity can be calculated by using trial and error method



6 OVERHEATING PROBLEM of building closest to boiler room can be corrected by use of third main which transforms circuit in Fig. 4 to reverse return system

error method of balancing becomes a hit or miss proposition. In the field, balancing is more of an art than a science and requires trained personnel not always readily available. It is for this reason that the engineer must try to design for hydraulic balance in order to make the system self-adjusting.

Difficulties with unbalanced systems are often compounded by the use of outdoor controlled three-way mixing valves. Almost all projects of this type employ weather compensated controls. As a result, not only are the buildings at the end of the loop "starved," but in addition, their water temperature is reduced in accordance with the outdoor temperature requirements.

In trying to get heat into buildings at the ends of mains, controls are often set to deliver much higher water temperature than is normally required. This causes serious overheating in the buildings near the boiler room.

One solution to problems of this type is shown in Fig. 6, where inherent balance is obtained by the use of a third main which transforms the circuit in Fig. 4 into a reverse return system. This has been attempted in several projects with which the writer is familiar and in every case the balancing problem was nonexistent.

It can be argued, of course, that the use of a third main adds to the first cost. However, figures available on existing projects have indicated that the additional cost is insignificant compared to the total cost of the project. This is especially so when it is considered how difficult it is to estimate the true labor cost of balancing a large system.

There are, of course, other methods to which the designer can resort in order to achieve a fairly balanced system (shortening distribution loops, having more boiler rooms, etc.), but these can be determined only on the basis of economics.

Another article to be published in an early issue will discuss other applications of hot water heating and will describe the widespread use of hot water in industry. Included will be some valuable pointers on system installation. ⧺

COMPLETELY AIR CONDITIONED structure comprises 11,000 seat arena, 1800 seat theater, as depicted at right

Steam Heats, Cools New Arena and Theater

BY GEORGE L. DAHL
Architect and Engineer

Dallas Memorial Auditorium is served year 'round by central plant consisting of two 775 ton steam turbine driven centrifugal compressors, two 15,000 lb per hr package water tube boilers.

DALLAS' NEW, completely air conditioned, $8 million Memorial Auditorium personifies the latest in functional architectural design. Located on a 23 acre site near the heart of the business district, the arena, under a cantilevered dome, will seat nearly 11,000 people. A theater and connecting wing will seat another 1800.

The main arena building is 300 ft in diameter, 105 ft high, and is in four levels. The theater building is 130 ft wide by 325 ft long and in three levels. The total area of all buildings is 422,710 sq ft and the volume is 8,936,100 cu ft.

A central equipment room houses the main refrigeration and heating components and auxiliaries necessary to distribute chilled water and steam to all of the air handling equipment as required.

The main refrigeration equipment consists of two 775 ton steam turbine driven centrifugal compressors. Each compressor turbine requires 11,200 lb of steam at 230 psig when operating at design conditions. Each compressor uses 2540 gpm of condenser water to condense the steam used by its turbine.

These compressors cool 5424 gpm of water down to 42 F prior to its being circulated to the air handling equipment.

The main heating equipment consists of two 15,000 lb per hr package type water tube boilers. Operating at 230 psig steam, these boilers supply steam for use in the centrifugal machine turbine. This steam pressure is reduced to 70 psig for distribution and is further reduced to 10 psig for use in the heating coils of the various pieces of air handling equipment.

Filter banks, consisting of combined electrostatic and activated carbon cells, clean and purify over 180,000 cfm of return air. These filter banks remove impurities from the air and also remove odors and tobacco smoke, enabling the system to reduce the quantity of outside air required for ventilation by an amount equal to 180,000 cfm. The reduction in quantity of outside air required amounts to an initial savings of over 650 tons of prime refrigeration equipment and a resultant additional savings in air handling equipment, piping, and sheet metal and a considerable operational savings in pumping and refrigeration costs.

The air handling equipment is divided into three categories: supply, recirculation, and exhaust.

The total combined supply air capacity is over 560,000 cfm. Approximately 134,000 cfm of air is recirculated to partially cool the concourses and less critical areas and the quantity of air exhausted varies up to a maximum of over 346,000 cfm.

The combined fan capacity is capable of handling over 1,040,000 cfm of air.

Under maximum operating conditions, over 18,000 gpm of chilled water, condenser water, and condensate are pumped continually. This water is distributed and collected through various piping systems having a combined length of over 11 miles.

An additional 3 miles of copper tubing is necessary to distribute the air for the pneumatic temperature control system.

The cooling tower has a volume of over 50,000 cu ft and its basin contains 52,000 gal of water.

The consulting engineers were Ammann & Whitney. The mechanical (heating, piping, and air conditioning) contractor was C. Wallace Plumbing Co. ∓

One-story plant construction, modern production processes . . .

Place New Importance on Design Of Industrial Air Supply Systems

The problems created by industrial production processes involving contaminants, the plant building design trend toward the broad one-story structure, and the resultant need for a good physical environment for employees have nurtured new design aspects for industrial air supply. Systems must control space conditions (including temperature and humidity, contamination, and air movement) and must provide for adequate makeup air. Good plant ventilation is an absolute necessity, and making the investment in a system pay off requires careful design, with no scrimping on components.

BY JOHN H. CLARKE
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Air Conditioning and Power
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Div. of Union Carbide Corp.

SINCE WORLD WAR II there has been an increase in the importance of ventilation and air conditioning in industrial plants. This has resulted from the great increase in production processes and methods that require control of contaminants and space conditions, from the trend to wide, long, integrated production areas for which the large single story structure is particularly well suited, and from the growing recognition of the fact that supply air fills a definite need and is a good investment in providing reasonable working conditions for employees.

The author is a member of the technical advisory committee on industrial environment of the American Society of Heating and Air-Conditioning Engineers. He has written several articles for Heating, Piping & Air Conditioning on the various aspects of operation and maintenance of heating, ventilating, and air conditioning equipment and systems in industrial plants.

Many years ago most ventilation for industrial areas was supplied by gravity ventilators, monitors, sawtooth roof construction for exhaust, and by peripheral openings, usually doors and windows, to admit the supply air. This supply air included the large quantities of dirt and dust inherent with natural supply ventilation.

For narrow, high ceilinged buildings this arrangement provided some relief. However, this was subject to the whims of the weather, considerable short circuiting of the ventilation air through the monitors and other roof openings, and high radiant loads from the sun through glass areas.

In the winter this same construction created equally difficult problems in heating because of the high infiltration and transmission losses through the ventilators and window areas.

Design Trend Outmoded Peripheral Ventilation

As the internal (power, lighting, and process) loads increased to three or four times the pre-war values it became increasingly evident that ventilation around the

periphery, actuated by gravity ventilators, was incapable of removing the heat generated in the plant areas.

The trend toward broad floor areas has also eliminated any value that peripheral ventilation may have had in providing air motion and heat relief at the center of the plant. The increase in plant size and the use of low buildings (which reduce the thermal head for natural ventilation) in order to provide better production facilities turned borderline or barely tolerable working conditions into critical ones.

Also, the process and contaminant removal requirements of the modern plant require vastly increased amounts of air supply and exhaust. And, finally, with a growing understanding of our plant labor problems has come an increased appreciation of the fact that good ventilation and air conditioning in plant areas, in order to provide a reasonable or good physical environment, will show a good return on investment. Obviously, the warmer the climate the more this is true. This may be reflected in better production, higher product quality, fewer errors, a lower accident rate, reduced absenteeism, less sickness, and reduced labor problems resulting from poor working conditions. In addition, plants with good working conditions can attract and hold higher quality employees.

These factors can and should be evaluated by the ventilation engineer in "selling" management on the need for these installations. Ordinarily, the costs should be amortized over a three to four year period. In many cases, for either ventilation or air conditioning, a one to two year payoff may result. As one acquaintance describes his approach to management, "It is not a question as to whether we can afford to provide it (ventilation or air conditioning), but can we afford *not* to provide it?"

Air Supply No Longer a Luxury

The above analysis is needed for those cases where improved working conditions will result in a good return on the investment. But what frequently is not realized is that today in hundreds of industrial plants supply air is no longer a *luxury* but is a *necessity*. Without it many plants could not operate safely even for a very short time. In others, walkouts or work stoppages would occur, or at best work could be carried on only under difficult and temporary conditions.

The cost of the necessary contaminant and process exhaust systems is not complete until the cost of complimenting makeup air is included. Thus, the cost of the supply system should often be amortized as a part of the overall project for an industrial exhaust system installation.

System Should Provide Various Services

The more ways that these systems can be useful in the plant the more value they can contribute, thereby affording a greater return on the investment. The various services these systems can perform come under two main categories:

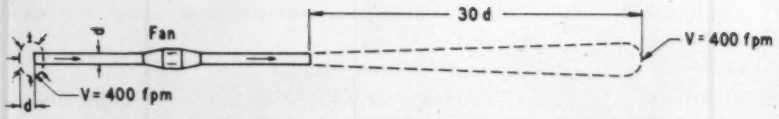
1) *Control of space conditions*

a) *Temperature and humidity control.* Because of process or product requirements, to prevent rusting of equipment, or to provide acceptable working conditions, a plant may require control of either temperature or humidity.

b) *Contaminant control.* Clean air to whatever extent desired may be provided to industrial areas by the supply air system. With a mechanical supply a source location may be selected which will minimize the reentry of contaminated air being exhausted from nearby outlets. In addition, clean air may be provided by filters, washers, or liquid or solid sorbents to remove dust, dirt, odors, fumes, mists, and bacteria. Contaminant control can also be provided by dilution ventilation. This does not infer that dilution control of contaminants is recommended. Wherever possible, contaminants should always be removed at their source by filtration, adsorption, or by local exhaust. Therefore, dilution should be used only as a last resort. However, since insurance and public health agencies usually require minimum ventilation rates, regardless of the local exhaust provided, dilution may be used to supplement local exhaust.

c) *Control of air movement.* This has many facets and, properly considered, is an important factor in providing good building ventilation. It is a fundamental principle that supply and exhaust ventilation each have certain characteristic values which are not interchangeable. Exhaust ventilation can remove fumes at the source, but it cannot control the direction of flow of air into and through a space. Supply air is inefficient in removing fumes, but injected into a space it will have a "throw" at least 30 times greater than the effective flow (or control) distance from an exhaust opening, as shown in Fig. 1. Consequently, supply air to a space is capable of being delivered to specific areas either to provide air movement (for heat relief in the summer) or to avoid air movement in areas where movement would disrupt proper exhaust hood operation or would create undesirable drafts on the workers in cool weather.

In addition, control of the amount of supply air (the exhaust is frequently a fixed amount) can aid control of space conditions and contaminants by creating either an inflow or outflow of air with respect to surrounding plant areas. This is often referred to as "pressurizing" (a misnomer, because such flow should seldom exceed 100 or 200 fpm). These velocities are equivalent to velocity pressures of 0.0006 and 0.0025 in. water gage. For a standard 8 ft × 8 ft plant door this would be equivalent to air movements of 6400 and 12,800 cfm, respectively. These are important figures because, while there is very little pressure involved, the air volumes moved are considerable. Pressures above 0.05 in. WG, which is equivalent to a velocity of 880 fpm, will cause trouble with infiltration or exfiltration, drafts, and the



Exhausting – Approximately 10% of face velocity at one diameter away from exhaust opening.

Q in pipe = 4000 cfm
A of pipe = 1 sq. ft
V in pipe = 4000 fpm

Blowing – Approximately 10% of face velocity at 30 diameters away from blowing opening.

1 SUPPLY AIR is inefficient in removing fumes, but injected into a space it will have a "throw" at least 30 times greater than the effective flow (or control) distance from an exhaust opening

Illustration courtesy "Industrial Ventilation — A Manual of Recommended Practice," published by American Conference of Governmental Industrial Hygienists.

opening of doors. Difficulty may also be encountered with equipment operating on convection or natural draft, such as furnaces and ventilators, even at very low pressure differentials such as 0.01 to 0.03 in. WG.

2) *Provide makeup air.*

It is obvious that all air required for combustion, process, contaminant exhaust, and the removal of odor, mist, humidity, and heat must be replaced by some means. This may be by infiltration or by natural or mechanical ventilation. Experience has shown that with few exceptions this air should be provided mechanically. In winter the air must be heated, regardless of the source. Supplied mechanically it can be tempered and distributed as necessary to provide good working conditions. On the other hand, while the infiltrated air may eventually become heated, it will cause great discomfort in the vicinity of the leakage. In many cases this can render the area unusable during very cold weather. Because of this, it has been found that, costwise, it is cheaper to heat and distribute the makeup air according to a predetermined pattern.

Design System Capable of Doing the Job

Having enumerated what these systems are capable of doing, consideration should be given to some of the design requirements for the installations. These are as follows:

1) The installation should do the job or jobs for which it is installed. This would seem obvious, but it is a discouraging fact that in hundreds of plants, millions of dollars have been poured into systems which fundamentally could never work. No more consideration was given to the specific design requirements of these systems than the average person would give to buying a pair of socks. Even if the system is properly designed, it will still be useless unless it is properly installed and operated.

2) The system should be designed and located for ease of operation and maintenance. For this reason there is a growing realization that large supply systems (100,000 to 200,000 cfm) of the builtup type provide better operation at less cost and at far less maintenance than a number of small, compact, hard-to-maintain units scattered around the plant.

3) The system should be reliable. As mentioned, supply air in the industrial plant is usually a necessity, and the design and quality of the equipment to provide it should reflect this fact. Gold plating is not required, but good solid equipment is. A beautiful exterior on a building may please the esthetic senses, but unless this front is backed up with mechanical equipment of good quality, neither the architect nor the engineer is earning his fee.

4) Freeze protection should be installed for those systems which handle outside air at freezing conditions.

5) Suitable control should be provided. Again, gold plating is not desired. But whatever system is provided, it should *control*. Overheating is just as poor control as underheating.

6) Good distribution should be provided for. Fundamentally, this means distribution of the air to the work zones in a manner required for good working conditions or good operation with respect to the hoods, process, or product.

7) The installation should be at a reasonable cost. This cost should reflect a good return on the investment and should be in keeping with the job to be done. The cost of the supply system, including provisions for makeup air, should be a part of the cost of installing the exhaust system.

Must Recognize Specific Problems

It has not been the intention of this article to point out all of the factors entering into the design of industrial air supply systems. Rather it is intended to point out the more pertinent requirements. Basically, the industrial systems are not unlike conventional systems. But the specific problems must be recognized, and it must be understood that the solutions are not clear cut. A great premium must be placed on design experience with similiar successful installations and with design information which has been gleaned from service and operating checks. ∓

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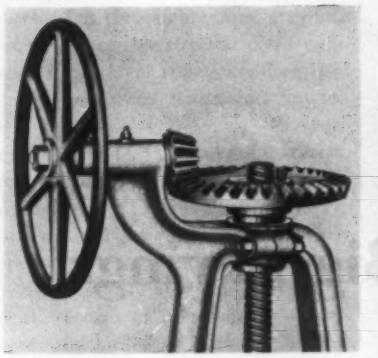
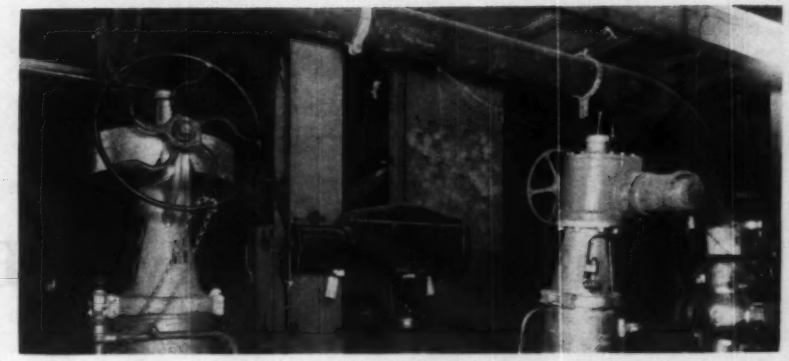


1 UNPROTECTED bevel gearing is open invitation to damage, danger



2 GEAR COVERS on these steel valves used on high pressure boilerfeed piping protect valves from dust, dirt, and other foreign matter, promote safety

Gear Covers, Valve Indicators Prove Valuable Piping Accessories

BY G. W. HAUCK
Manager, Engineering Sales
Crane Co.

Two piping additions that prove extremely useful in achieving greater convenience and safety in piping systems are protective covers for valve gears and valve indicators that show whether valves are open or closed. Seemingly small items, in the right place and at the right time each of these accessories can pay its own way.

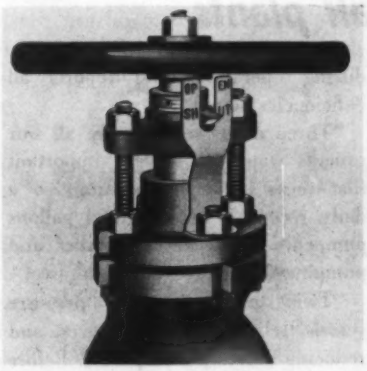
Bevel gearing on the upper structure of an outside screw and yoke gate valve, shown in Fig. 1, is unprotected. Gear covers can be added, as shown in Fig. 2, to gain two benefits. The gear covers prevent obstruction of or damage to the gears from dust, dirt, and other foreign matter. Covering the gears also provides safety for the operator.

Is the valve open or closed? If it's an outside screw and yoke or a rising stem type of valve, a glance answers this question. However, it's not that simple if it is a non-rising stem valve; in this case, the position of the disc cannot be determined instantly.

If it's an iron body, non-rising stem valve, 12 in. or smaller, the simple, inexpensive indicator shown in Fig. 3 can be applied. It saves time and perhaps some confusion by showing at a glance whether a valve is open or shut. The pressure seal bonnet valves, shown in Fig. 4, at high pressure heaters are equipped with indicators. ∓

The author is a member of Heating, Piping & Air Conditioning's board of consulting and contributing editors and has prepared numerous articles for publication in its pages.

This is the concluding article of a series describing piping hookups and accessories. Previous articles appeared in the September 1957 through March 1958 issues.



3 VALVE INDICATOR shows at a glance whether valve is open or closed

4 OPEN OR SHUT? Valve indicators installed on these pressure seal bonnet valves at high pressure heaters tell instantly, saving time and confusion

IN PLANT OPERATION —

Maintenance Is Key to Big Savings

. . . through cooperation, planning

Good plant maintenance means money in the pocket. Today plant management is better sold than ever on the function and opportunities which the proper conduct of maintenance offers toward reducing operating and replacement costs and minimizing downtime.

Such were the thoughts reflected at the recent ninth annual Plant Maintenance and Engineering Conference in Chicago.

The savings that can be realized are considerable. For instance, one speaker said that his company could save well in excess of $1 million annually by the elimination of high repair costs, at least another $500,000 annually by savings through improved work execution, and additional amounts by reducing capital investments chargeable to maintenance. To reap these benefits management needs the unreserved cooperation of all who perform maintenance.

The maintenance problem was dealt with in many aspects in general sessions, panel discussions, and smaller group meetings. From those of special interest to heating, piping, and air conditioning engineers and contractors, we present here the highlights in abstracts of the speakers' own words.

• preventive maintenance pays off in small plants

"PERCENTAGEWISE, preventive maintenance in a small plant is just as important as in a large one," stated J. M. Abernathy, plant engineer, American Cyanamid Co., Kalamazoo, Mich.

"Several years ago we asked one of the major oil companies to send in a lubricating engineer. He made a complete survey of our equipment and made recommendations as to the frequency and type of lubrication to be used. When new equipment is added or trouble develops, we consult with him. This has been a very satisfactory program, has saved us money, and has reduced the stocking of different types of lubricants to a minimum.

"One of our maintenance men is the oiler. He is governed by a prescribed set of instructions which includes a tour he is to follow, the parts to be lubricated, the types of lubricants to be used, and the frequency of oil change. This man also acts as an inspector of equipment during operation, and reports all deficiencies found.

"Three deep wells supply all our process water. It is very important that these be kept operating, so a daily record is kept of total gallons pumped. Also, weekly static and pumping levels are checked.

"Twice a year boilers, pressure vessels, relief and safety valves, and reducing valves are inspected. Before the annual acid plant turnaround all equipment that lends itself to

checking is thoroughly gone over and tested, if possible, by the plant engineer, department superintendent, and chief chemist to determine the extent of repairs needed. Pressure tests are made on absorption towers, heat exchangers, catalyst beds, etc., to determine where cleaning is required. All pumps are checked against their performance curves.

"By regularly analyzing the equipment record of machinery, equipment, and buildings, we can pinpoint our low and high cost maintenance items, downtime, and repetitive jobs. Based on this analysis, we can revise frequency of inspection, correct the weak spots, substitute better materials, change methods of operation, or use better equipment.

"As an example, in our aluminum sulfate plant we have saved money by *not* repairing lead pipe and valves. Instead, tests were made on glass fiber epoxy impregnated pipe and on a cast iron neoprene lined valve with a stainless steel butterfly disc. The lead pipe and old type valves have been replaced by these. No leaks have developed to date. By the way, the salvage value of the lead paid for the new pipe.

"Aids to preventive maintenance are material research, design changes, and maintenance training. In a small plant this can be done at less cost and with less red tape than in a large one.

"Planning and scheduling depends a great deal on cooperation from the production department, by their giving plenty of time before a job must be done. We can schedule and plan about 70 percent of our work," concluded Mr. Abernathy.

• schedule should detail maintenance operations

"THE MAINTENANCE SCHEDULE in our plant puts the emphasis on preventive maintenance and includes nearly every detail of the major plant equipment," said Svante Eikrem, plant engineer, Hyster Co., Portland, Ore. "It outlines periods of maintenance — daily, weekly, monthly, yearly — together with the maintenance operation to be performed.

"For example, our maintenance schedule includes a procedure to be followed for electric motors. It is difficult to set a definite rule to apply equally to every motor, for experience will indicate that some motors will need more attention than others because of their construction or conditions under which they operate."

Mr. Eikrem outlined the following maintenance steps taken in his plant for particular motor types:

Sleeve bearing and wick oiled motors:

1) Lubricate once a month. Only a few drops of oil in the cups and level in the wick reservoir are necessary.

2) Clean once a year.

Ball bearing motors:

1) Remove grease fitting from motors and replace with pipe plug. This will eliminate overgreasing the bearing.

2) Clean motors once a year.

Wound rotor motors:

1) Examine collector rings and brushes every three months. Look for accumulation of carbon dust from brushes and metal from collector rings. Check brushes and rings for wear.

2) Test insulation every three months. Carbon dust and metal may have reduced resistance as well as air gap.

3) Examine resistor and drum controller every three months. Check connections for tightness.

"A keynote of our maintenance program is our attitude," Mr. Eikrem continued, "for not only have we improved efficiency by means of regular schedules of inspection, servicing, and repair, but also have shaken the tradition that a maintenance man is some kind of janitor, and have thereby created a feeling of recognition and pride in achievement.

"One important step in accomplishing these conditions has been the weekly meetings of the factory manager, maintenance supervisor, and plant engineer. At these meetings we discuss our problems no matter how big or small, and particularly review projects that seem to be lagging.

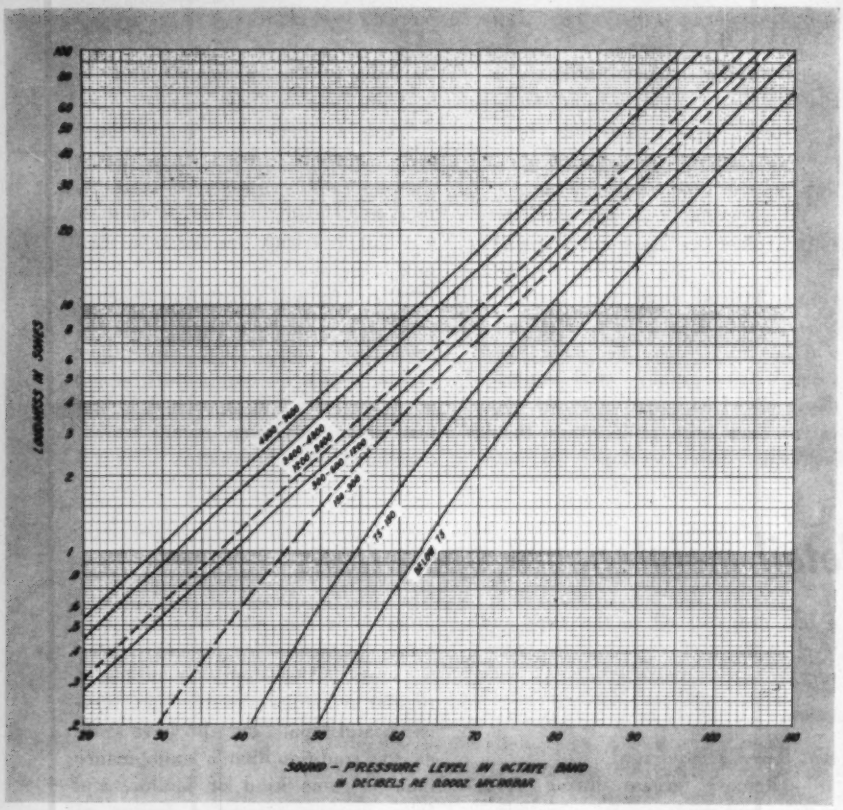
"These discussions have developed a more complete understanding between the factory manager, maintenance supervisor, and plant engineer, and this understanding is perhaps the single most important factor in putting into effect a successful maintenance program," he concluded.

• power waste is money down the drain

"PERHAPS every plant can't improve its load factor or power factor, but every plant, large and small, can reduce its power bill by eliminating waste uses of power," stated L. G. Cannon, manager of power service, Commonwealth Edison Co., Chicago.

"Personally, I belong to the generation that believes in turning off the lights when I am the last one to leave the room. Old fashioned thrift is still the surest way to save money.

"I have seen compressed air jets used by workers in hot areas to cool themselves off when fans would do the job better and at less cost. On dust collecting systems it is not uncommon for the workers to neglect to close air valves on idle machines, a waste of power which the meter is unable to ignore." ∓



1 FOR OCTAVE BANDS of noise, loudness varies with sound pressure level. Use of chart to derive total loudness is improvement over earlier equivalent tone method

New Method Simplifies Predicting Noise Levels

. . . created by fans, similar equipment

Room noise levels based on internal noise sources have long been difficult to predict due to the complex calculation necessary to arrive at single figure decibel levels—and then the results thus achieved do not give a true indication of noise loudness. Here, the author presents a new concept to the prediction of noise loudness. It is based on relative terms which are understandable to all. The method considers sound frequency as well as sound pressure or energy (decibels).

BY R. A. GERLITZ
Chief Engineer
Propellair Div.
Robbins & Myers, Inc.

How MUCH does room noise level increase when a fan or other noise source is installed in a room? What is the overall loudness of two or more noises compared with one? Just what noise levels are considered "quiet," "moderate," or "loud" in a given situation? Predictions can be made in terms of decibels, but the calculations are complex and the results are difficult to comprehend even by the experienced acoustical engineer. They are still more difficult to describe to the user.

Here is a simple and understandable method of predicting noise loudness based upon such relative terms as

"twice as loud" or "70 percent reduction in loudness." After all, that is what the user really wants to know. People are continually making comparative rather than absolute judgments: "How much louder is A than B?" —not "How loud is A?" Even when the latter question is asked, a comparison with some other sound is in the mind of the questioner. This seems to be part of our psychological nature. The same has been found for judgments of brightness, distance, velocity, heaviness (of lifted weights), finger span, and other quantities.

Single Figure Decibel Ratings Obsolete

It must be emphasized that single figure overall decibel levels do not give a true indication of noise loudness. Noise ratings on such a basis are obsolescent.

The fan industry, which wrote the original sound test code for single figure decibel ratings, has now dropped it as inadequate. In its place is being developed a code which considers sound frequency as well as sound pressure or energy. Acoustical specialists unanimously and universally agree that both sound pressure level (decibels) and frequency must be known in assigning noise loudness ratings.

Such information is obtained by octave band analyses which give curves of sound pressure level *vs* frequency. From such a curve the loudness of each octave band as well as the overall loudness, in sones, is easily obtained. The reader is reminded that sones are linear units of loudness, such that 20 sones sound twice as loud as 10 sones, and 5 sones half as loud as 10. These are units which people can grasp and understand—like dollars and cents, feet and inches, pounds, gallons.

Specifically, this article deals with fans, but it is also applicable to other noises, so long as the noises are similar to one another. The equations and charts given are mathematically rigorous for individual octave bands and for overall sounds with similar spectrums; that is, sounds with similarly shaped curves of sound level *vs* frequency, so long as the sounds fall within the straight line portions of Fig. 1. Calculations and charts given herein do not apply, generally, to very low noise levels nor to sounds whose peak octave band levels occur at low frequencies (below 150 cycles per sec).

Sound Decreases with Inverse Square Law

The behavior of sound energy can perhaps best be understood by visualizing the sound source as a point in space with spherical sound pressure waves radiating from it uniformly in all directions. The total sound energy becomes distributed over an increasingly larger area as it progresses from the point source and the sound intensity (sound energy per unit of area) decreases in accordance with the inverse square law.

In other words, the sound intensity drops to one-fourth for a doubling of distance. This represents a decrease of 6 db according to the formula $db_1 - db_2 = 20 \log r_2/r_1$, where r is the distance from the source.

Conventional noise level ratings for fans generally state the sound pressure level at a distance of 5 ft from the edge of the housing. This refers to the sound pressure or sound energy per unit of area at that distance. The total sound power is equal to all of the sound energy radiating through the surface of an imaginary sphere surrounding the sound source.

Expressed in decibels, this is known as the power level referred to 10^{-13} watts. For a noise source radiating its sound energy uniformly in all directions, the power level (PWL) is related to the sound pressure level (SPL) at distance r ft, according to:

$$PWL = SPL + 20 \log r + 10.5 \text{ db} \quad \text{.....[1]}$$

For a sphere of 5 ft radius the relation is:

$$PWL = SPL_{rated} + 24.5 \text{ db}$$

or:

$$SPL_{rated} = PWL - 24.5 \text{ db} \quad \text{.....[2]}$$

When the sound source is confined in a nonabsorbent room, the repeated reflections added to the direct radiation causes the sound pressure level to build up to a uniform level throughout the room—disregarding standing wave patterns. The resultant room noise level is therefore very much higher than stated in conventional fan noise ratings which give the noise level as measured outdoors in space at a distance of 5 ft. Since rooms are never 100 percent absorptive, some noise buildup always occurs above that in open air where reflection is zero. Mathematically, the relation for nondirectional sound in a room is:

$$SPL_{actual} = PWL + 10 \log [(1/4\pi r^2) + (4/R)] + 0.5 \text{ db} \quad \text{.....[3]}$$

where:

room constant $R = \alpha S/1 - \alpha$

S = total room surface area, sq ft (Elsewhere in this article, S signifies loudness in sones)

α = average absorption coefficient of room surfaces

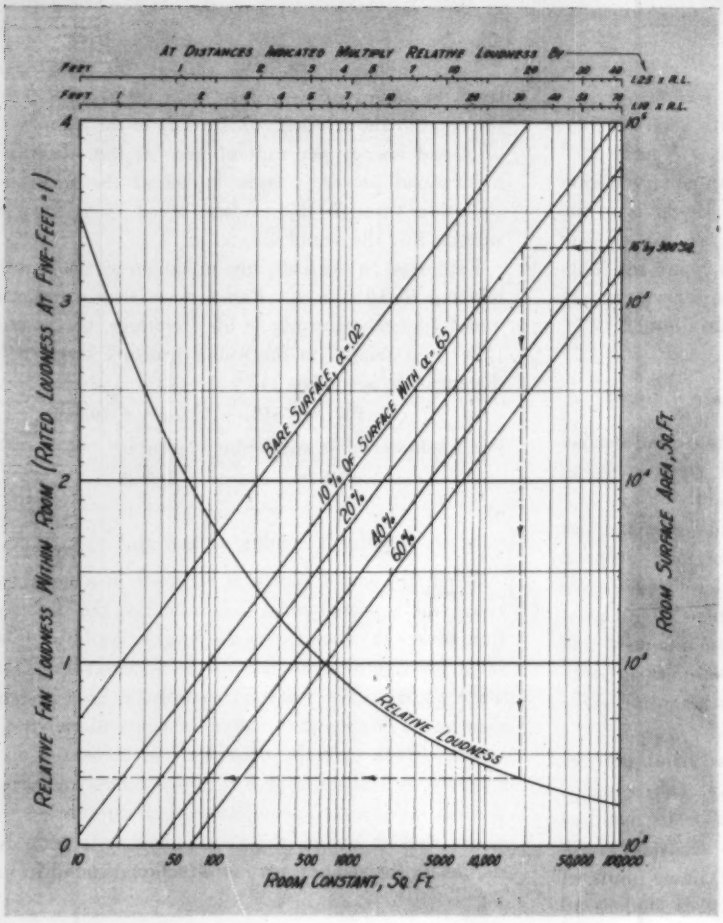
r = distance from noise source, ft.

This relation is valid only where the average absorption coefficient is less than one-half, or where it approaches unity. The difference in sound pressure level, then, between the actual inside a room and that at the 5 ft rating is the difference between Equations 3 and 2.

$$SPL_{actual} - SPL_{rated} = 10 \log [(1/4\pi r^2) + (4/R)] + 25 \text{ db} \quad \text{.....[4]}$$

This equation assumes the sound source to be a point at the center of an imaginary sphere of 5 ft radius, with the sound rating point on the surface of the sphere. For actual fans the sphere is somewhat larger because the point of noise measurement is 5 ft from the edge of the housing rather than 5 ft from the center. However, the practical difference is negligible for all except very large fans. For example, a 42 in. fan would produce ½ db higher noise level than the formula predicts, which represents only a 3½ percent error in predicted loudness.

In those cases where noise rating measurements are made on the basis of power level rather than sound pressure level at 5 ft, the PWL rating is easily converted to


At Distances Indicated Multiply Relative Loudness By
Feet
1 2 3 4 5 7 10 20 30 40
1.25 x R.L.
Feet
1 2 3 4 5 7 10 20 30 40 50 70
1.40 x R.L.
Relative Fan Loudness Within Room (Rated Loudness At Five-Feet = 1)
Bare Surface, α = .02
10% Of Surface With α = .65
20%
40%
60%
Relative Loudness
15' by 300 Sq.
Room Surface Area, Sq. Ft.
Room Constant, Sq. Ft.
10 50 100 500 1000 5000 10,000 50,000 100,000
0 1 2 3 4
10² 10³ 10⁴ 10⁵ 10⁶

2 ROOM EFFECT on fan loudness for wall mounted fans plotted here. Curves present simple means for predicting percentage of increase or decrease of fan loudness within room compared with its rated loudness at 5 ft

SPL (at a distance of 5 ft from the center) by means of Equation 2. The octave band sound pressure levels can then be converted to the sone loudness rating at 5 ft. Such a rating is more meaningful and easier to visualize than is a power level rating, and is no less precise in any sense. Sound power level need never enter into calculations once the original rating conversion of Equation 2 has been accomplished.

For octave bands of noise, the loudness varies with sound pressure level according to the chart in Fig. 1. The total loudness S_t in sones is given by:

$$S_t = S_m + 0.3\ (\Sigma S - S_m) \quad \text{.....[5]}$$

where:

S_m = loudness of loudest band
$\Sigma S - S_m$ = sum of loudness of all remaining bands

This finding is an improvement over the earlier equivalent tone method. It represents the results of about 5000 tests.

From the slope of the straight portions of the curves in Fig. 1 the following relation is derived:

$$\log\ (S_2/S_1) = 0.03\ (db_2 - db_1) \quad \text{.....[6]}$$

which gives the percentage of increase or decrease in loudness with a given db change. The equation holds true for the total loudness of one or more octave bands or for the full spectrum, provided that the change in db level is uniform over the spectrum. Furthermore, it can be used to compare the loudnesses of two or more noises with similarly shaped spectrum level curves. The ratio S_2/S_1 indicates the relative loudness of S_2 compared with S_1 taken as unity. In other words, when $S_2/S_1 = 1.5$, then S_2 is 50 percent louder than S_1.

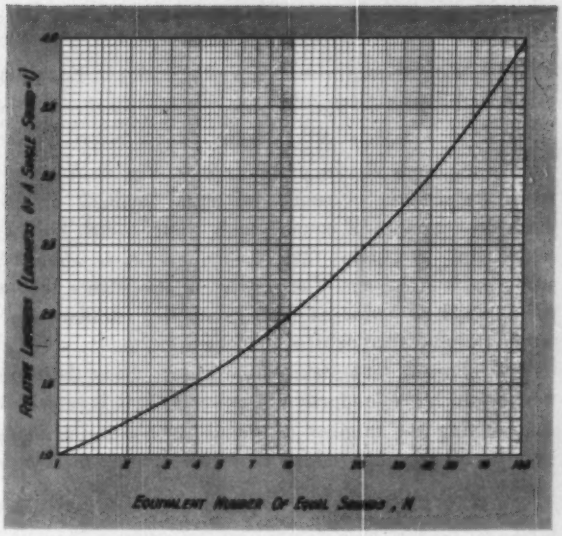
Combining Equations 4 and 6 gives:

$$\log\ (S_2/S_1) = 0.03\ [10\ \log\ [(1/4\pi r^2) + (4/R)] + 25\ db] \quad \text{.....[6a]}$$

which predicts the relative loudness of a noise within a room compared with its rated loudness at 5 ft. The term $1/4\pi r^2$ indicates that, at locations near the noise source, loudness decreases with increasing distance, while at more remote locations this term becomes insignificantly small and the loudness tends to become uniform so that no further decrease occurs with increasing distance. This, of course, assumes the reverberant noise field to be diffuse, without standing waves. This is very nearly true in large irregular rooms or rooms occupied by irregular objects such as machinery, desks, people, etc.

Half of Noise Energy Radiated to Outdoors

In the case of wall mounted exhaust or supply fans it may be assumed that approximately one-half of the noise energy is radiated into the room and the other half to the



3 AS LOUDNESS of similar noise spectrums are added, total noise increases at decreasing rate. For example, 10 identical noises would be only twice as loud as one

outdoors. For this case the 25 db term of Equation 6a becomes 22 db. Thus, dropping the $1/4\pi r^2$ term and using 22 in place of 25, we have:

$$\log (S_2/S_1) = 0.3 [\log (4/R) + 2.2]$$

which simplifies to:

$$S_2/S_1 = (634/R)^{0.3} \quad \ldots\ldots\ldots\ldots\ldots\ldots [7]$$

For circulator fans or other noise sources where all of the noise energy is radiated into the room, the 25 db term is used instead of the 22 db term, and Equation 7 becomes:

$$S_2/S_1 = (1268/R)^{0.3}$$

or:

$$S_2/S_1 = (634/R)^{0.3} (2)^{0.3} = (634/R)^{0.3} \times 1.23$$

In other words, circulator fans would be 23 percent louder than when used as wall mounted ventilating fans.

The curves of Fig. 2 were derived from Equation 7 and the room constant equation, $R = \alpha S/(1 - \alpha)$, and present a simple means for predicting the percentage increase or decrease of fan loudness within a room compared with its rated loudness at 5 ft. The relative loudness curve is for points remote from the noise source. In actual practice, however, only slight error will result at distances as near as the following:

Room constant R	Minimum distance from noise for accuracy of Fig. 2, ft
10	1
100	3
1000	9
10,000	25 (at 10 ft 39 percent louder than Fig. 2)
100,000	85 (at 25 ft 54 percent louder than Fig. 2)

The two scales at the top of Fig. 2 give the distances at which loudness exceeds the relative loudness curve by 10 and 25 percent, respectively.

Weigh Effect of Acoustical Insulation

It will be seen that a direct estimate of the room constant can be made from Fig. 2 by means of the family of sloping straight line curves. The curve "bare surface α = 0.02" is for rooms with bare walls, ceilings, and floors of sheet steel, glass, brick, concrete, plaster, or other hard, nonporous materials which generally have absorption coefficients of approximately 0.02. The other curves in the family are for rooms which are partially treated with acoustical insulation, the remainder of the room being bare ($\alpha = 0.02$). The assumption is, of course, that the acoustical material is more or less uniformly distributed over the room—certainly not all of it at one end of a large room, for example.

The indicated absorption coefficient of 0.65 is average for the more common sound absorbing materials. Strictly speaking, the chart assumes equal noise absorption at all frequencies, while in actual practice absorption coefficients usually fall off greatly at the lower frequencies. In most cases this is of little consequence because it is outside the range of general interest where the ear is relatively insensitive. However, large errors are possible if the chart is misapplied to low frequency rumbling noises where absorption coefficients are low.

An example of the application of Fig. 2 is indicated by the dotted line. This shows the effect of a room 300 ft square with a ceiling height of 16 ft and with 10 percent of its interior surfaces treated with acoustical material having an absorption coefficient of 0.65. The room constant is shown as 18,000 and the relative fan loudness for that constant is 0.37. This means that a 100 sone fan installed in the room would be only 37 sones loud at locations more than 25 ft from the fan. Actually, equipment and people inside the room would provide somewhat greater absorption than predicted, resulting in lower noise level.

What About Sounds Added Together?

When a number of identical sounds are added together the sound pressure level changes according to:

$$db_2 - db_1 = 10 \log N \quad \ldots\ldots\ldots\ldots\ldots\ldots [8]$$

where:

N = number of sounds.

Substituting this expression for $db_2 - db_1$ in Equation 6 and simplifying gives:

$$S_2/S_1 = N^{0.3} \quad \text{.....[9]}$$

This equation is shown graphically in Fig. 3. N represents the number of sounds of equal loudness or the equivalent number of equal sounds being added. For example, the chart shows that 10 identical noises would be twice as loud as one. Conversely, it also shows that a noise which is twice as loud as another similar noise would be equivalent to 10 of the lesser.

The following table, taken from Fig. 3, shows the manner in which the loudnesses of noises add. It is seen that quadrupling the number of sounds increases the loudness by 50 percent, and 10 times the number of sounds increases the loudness by 100 percent. Here we have an easily remembered relationship.

Number of equal sounds	Relative loudness
1	1.0
4	1.5
10	2.0
40	3.0
100	4.0

Only similar sounds can be added in this manner. Actual loudnesses for dissimilar spectrum shapes will be greater than Equation 9 predicts. Again, if we consider only the most important part of the spectrum (150 to 4800 cps), results will be fairly good even though the spectrum shapes are not strictly similar.

The practical application of the noise level principles described will be illustrated in another article in an early issue. ∓

Interpret Pressure Piping Code

HEATING, PIPING & AIR CONDITIONING *periodically publishes for the information of interested parties certain actions of the Sectional Committee B31 on the American Standards Code for Pressure Piping, sponsored by the American Society of Mechanical Engineers. While these actions do not constitute formal revision of the code, they represent the considered opinion of the committee.*

Pending revision of the Code for Pressure Piping, ASA B31.1-1955, the committee has recommended that ASME make public certain interpretations.

The following are interim actions and will not constitute a part of the code until formal action has been taken by ASME and by the American Standards Association.

Case No. 30

Inquiry: May piping be designed and constructed under Division A of Sections 3 and 5 of ASA B31.1-1955 Code for Pressure Piping for service temperatures below −20 F?

Reply: It is the opinion of the committee that piping within the scope of Division A of Sections 3 and 5 of ASA B31.1-1955 may be designed and constructed for service temperatures below −20 F provided that the following conditions are met:

1) The materials used for pressure containing parts and stress carrying structural elements intimately attached to the pipe shall conform to the appropriate specifications and shall be used within the indicated temperature and stress limitations shown in Table 1.

2) All such materials shall be impact tested and meet the requirements of Paragraph UG-84 of Section VIII of the ASME Boiler and Pressure Vessel Code, with the following exceptions:

a) Austenitic chromium-nickel steels with not more than 0.10 percent carbon, except weld metal.

b) Nonferrous materials.

c) Bolting materials to ASTM A-193 B7 and B7A.

3) A set of test specimens shall be made to test the weld metal and the heat affected zone of the base material for each range of ¼ in. of pipe thickness used.

4) Welded joints in piping which is to operate at temperatures below −20 F shall be stress relieved in accordance with the methods specified in Paragraph 632 of ASA B31.1-1955, except that those materials which are exempt from impact tests need not be stress relieved.

5) Thermal expansion data for materials in low temperature services are given in Table 2.

6) Moduli of elasticity and torsional rigidity of ferrous and nonferrous materials in low temperature services are given in Table 3.

TABLE 1—MATERIALS used for pressure containing parts and stress carrying structural elements intimately attached to pipe shall conform to appropriate specifications, be used within these indicated temperature and stress limitations

ASTM Specification	Material	Grade	Minimum temperature, F	Maximum allowable stress, psi
A193	Alloy steel bolting materials for high temperature service	B7	−50	20,000
		B7A	−50	20,000
A333	Seamless and welded steel pipe for low temperature service	C	−50	18,350
		3	−150	21,650
		5	−150	21,650
A334	Seamless and welded steel tubes for low temperature service	C	−50	18,350
		3	−150	21,650
		5	−150	21,650

Table 1 (continued)

ASTM Specification	Material	Grade	Minimum temperature, F	Maximum allowable stress, psi
A312	Seamless and welded austenitic stainless steel pipe	TP 304	−325	18,750
		TP 309	−325	18,750
		TP 310	−325	18,750
		TP 321	−325	18,750
		TP 347	−325	18,750
		TP 316	−325	18,750
		TP 317	−325	18,750
A358	Electric fusion-welded austenitic chromium-nickel alloy steel pipe for high temperature service	S	−325	16,000
		M	−325	16,000
		C	−325	16,000
		T	−325	16,000
		309	−325	16,000
		310	−325	16,000
A352	Ferritic steel castings for pressure containing parts suitable for low temperature service	LCB	−50	16,250
		LC1	−75	16,250
		LC2	−100	16,250
		LC3	−150	16,250
A376	Seamless austenitic steel pipe for high temperature central station service	TP 304	−325	18,750
		TP 321	−325	18,750
		TP 316	−325	18,750
		TP 347	−325	18,750
A249	Welded austenitic stainless steel boiler, superheater, heat exchanger and condenser tubes	TP 304	−325	16,000
		TP 310	−325	16,000
		TP 316	−325	16,000
		TP 317	−325	16,000
		TP 321	−325	16,000
		TP 347	−325	16,000
A271	Seamless austenitic chromium-nickel steel still tubes in refinery service	TP 304	−325	18,750
		TP 321	−325	18,750
		TP 347	−325	18,750
A269	Seamless and welded austenitic stainless steel tubing in general service	TP 304	−325	18,750
		TP 316	−325	18,750
		TP 317	−325	18,750
		TP 321	−325	18,750
		TP 347	−325	18,750
A182	Forged or rolled alloy steel pipe flanges, forged fittings and valves, and parts in high temperature service	F 304	−325	18,750
		F 347	−325	18,750
		F 321	−325	18,750
		F 316	−325	18,750
		F 310	−325	18,750
		F 10	−325	18,750
A350	Forged or rolled carbon and alloy steel flanges, forged fittings and valves, and parts in low temperature service	LF 1	−50	18,750
		LF 3	−150	23,250
A351	Ferritic and austenitic steel castings for high temperature service	CF8C	−325	17,500
		CF8M	−325	17,500
A300	Steel plates for pressure vessels for low temperature service			
		Class 1	−50	
	Flange or firebox quality	A201A		13,750
	Flange or firebox quality	A201B		15,000
		Class 2	−75	
	Firebox quality	A203A		16,250
	Firebox quality	A203B		17,500
		Class 3	−150	
	Firebox quality	A203D		16,250
	Firebox quality	A203E		17,500
		Class 4	−320	
		A353		22,500
A320	Alloy steel bolting material in low temperature service	L 7	−150	20,000
		L 10	−150	20,000
		L 43	−150	20,000
		L 9	−225	20,000
		B 8	−325	15,000
		B8C	−325	15,000
		B8P	−325	15,000
B164	Nickel-copper alloy forgings	A	−325	20,000
B160	Nickel forgings, low carbon nickel		−325	10,000
B247	Aluminum alloy forgings	GS 11B	−325	9,000
		GS 11A	−325	9,500
	Aluminum alloy forgings	M1A	−325	3,350

Note: In the above tabulation where the specification covers *both* seamless and welded pipe, only the stress value of the seamless material is shown. The stress value for welded pipe shall be the stress value of the seamless material multiplied by the following joint factor:

1) For resistance welded pipe	Joint factor 0.85
2) For fusion welded pipe with weld metal deposited from *one* side only	Joint factor 0.85
3) For fusion welded pipe with weld metal deposited from *both* sides	Joint factor 0.90
4) Where welded pipe joint is completely radiographed as required by the appropriate specifications	Joint factor 1.00

Where the tabulated specification covers *only* welded material, the stress value shown includes the 0.85 joint factor.

TABLE 2—THERMAL EXPANSION data for materials in low temperature services given here

Material	Coefficient[a]	Temperature range, F: 70 to 200	−50 to 70	−150 to 70	−325 to 70
Carbon steel; carbon-moly steel low-chrome steels (through 3 percent Cr.)	A	6.38	5.80	5.50	5.00
	B	0.99	0.84	1.45	2.37
Intermediate alloy steels; 5Cr, Mo, through 9 Cr, Mo	A	6.04	5.45	5.20	4.70
	B	0.94	0.79	1.37	2.22
Austenitic stainless steels	A	9.34	8.90	8.60	8.15
	B	1.46		2.27	3.85
Straight chromium stainless steels; 12 Cr, 17 Cr and 27 Cr	A	5.50	5.00	4.70	4.30
	B	0.86	0.72	1.24	2.04
25 Cr — 20 Ni	A	7.76	7.20	6.85	6.35
	B	1.21	0.98	1.81	3.00
Monel 67 Ni — 30 Cu	A	7.84	7.15	6.75	5.55
	B	1.22		1.79	2.62
Monel 66 Ni — 29 Cr, Al	A	7.48	6.80	6.45	5.35
	B	1.17	0.98	1.70	2.53
Aluminum	A	12.95	11.60	10.90	9.90
	B	2.00	1.67	2.88	4.68
Gray cast iron	A	5.75			
	B	0.90			
Bronze	A	10.03	9.15	8.75	8.40
	B	1.56	1.32	2.31	3.98
Brass	A	9.76	8.95	8.50	8.20
	B	1.52	1.29	2.24	3.88
Wrought iron	A	7.32	6.65	6.30	5.70
	B	1.14	0.96	1.67	2.70
Copper-Nickel (70-30)	A	8.54	7.80	7.40	6.65
	B	1.33	1.13	1.95	3.15

[a]A = Mean coefficient of thermal expansion by 10^6, in. per in. per F deg; B = Linear thermal expansion, in. per 100 ft

This data is for information and it is not to be implied that materials are suitable for all the temperature ranges shown. Temperature limits are set out in Table 1.

TABLE 3—MODULI OF ELASTICITY and torsional rigidity of ferrous and nonferrous materials in low temperature services listed

Material	Modulus[a]	Temperature, F: 70	0	−100	−200	−325
Carbon steels with carbon content 0.30 percent or less	E	27.9	28.6	29.0	29.5	30.0
	G	10.8	11.1	11.2	11.4	11.6
Carbon steels with carbon content above 0.30 percent	E	29.9	30.2	30.4	30.6	31.0
	G	11.6	11.7	11.8	11.9	12.0
Carbon-moly steels, low Cr-moly steels through 3 percent Cr	E	29.9	30.2	30.4	30.6	31.0
	G	11.6	11.7	11.8	11.9	12.0
Intermediate Cr-moly steels (5 to 9 percent Cr), austenitic stainless steel	E	27.4	27.7	28.1	28.5	29.4
	G	10.6	10.7	10.9	11.0	11.4
Straight chromium stainless steel (12 Cr, 17 Cr, 27 Cr)	E	29.2	29.5	29.8	30.3	30.8
	G	11.4	11.5	11.6	11.8	12.0
Wrought iron	E	29.5	29.8	30.0	30.2	30.6
	G	11.8	11.9	12.0	12.1	12.2
Gray cast iron	E	13.4				
	G					
Monel 67 Ni — 30 Cu	E	26.0	26.2	26.4	26.6	26.8
66 Ni — 29 Cr, Al	G	9.5	9.6	9.7	9.7	9.8
Copper — Nickel 80 — 20, 70 — 30	E	18.9	19.2	19.5	20.0	20.5
	G					
Aluminum	E	10.6	10.7	10.9	11.1	11.3
	G	3.9	3.9	4.0	4.1	4.2
Copper 99.98 percent Cu	E	16.0	16.2	16.5	16.7	17.0
	G	6.0	6.1	6.2	6.3	6.4
Commercial brass 66 Cu, 34 Zn	E	14.0	14.2	14.5	14.7	15.0
	G	5.3	5.4	5.5	5.6	5.7
Leaded tin bronze 88 Cu, 6 Zn, 1.5 Pb 4.5 Zn	E	13.0	13.2	13.5	13.8	14.2
	G	4.9	5.0	5.1	5.2	5.4

[a]E = Modulus of elasticity (multiply by 10^6); G = Modulus of torsional rigidity (multiply by 10^6).

This data is for information and it is not to be implied that materials are suitable for all the temperature ranges shown. Temperature limits are set out in Table 1.

Case No. 31

Inquiry: May steel pipe produced under ASTM Specification A381-54T be used in construction that must comply with ASA B31.1, Section 8, Gas Transmission and Distribution Piping Systems? If so, what joint factor may be used?

Reply: It is the opinion of the committee that pipe meeting the requirements of ASTM Specification A381-54T meets the intent of the code and may be used under ASA B31.1.8 and with a longitudinal joint factor *E* of 1.

Case No. 32

Inquiry: Is the use of centrifugally cast steel pipe permissible under Section 3 of ASA B31.1-1955 Code for Pressure Piping?

Reply: It is the opinion of the committee that centrifugally cast steel pipe is suitable for use in piping systems under Section 3 of ASA B31.1-1955 Code for Pressure Piping if the following requirements are met:

1) The pipe shall meet the requirements of ASTM Specifications A216, A217, or A351, except that the hydrostatic test shall be as specified in Paragraph 6 of this case.

2) The pipe shall have both the inner and outer surfaces machined to a finish not coarser than 250 rms after heat treatment.

3) Each pipe after machining shall be examined on the inside and outside surfaces, including ends, by magnetic particle inspection or liquid penetrant method of surface inspection whichever is feasible for the material. When magnetic particle inspection is used it shall be made in accordance with ASTM E109 and defects revealed shall be repaired. When liquid penetrant method is used, any cracklike defects revealed shall be repaired.

4) Each piece of ferritic alloy pipe having wall thickness greater than 1 in. shall be ultrasonically tested throughout its length after machining to determine its soundness by either the shear or longitudinal methods. Defects in excess of 5 percent of the wall thickness will not be permitted.

5) Austenitic castings are not amenable to ultrasonic inspection. Where specified on the purchase order, pipe may be partially or completely radiographed. Pipe showing defects as judged by the Industrial Radiographic Standards for Steel Castings (ASTM E71, Cl. II) shall be repaired.

6) Each length of pipe, after machining, shall be tested by the manufacturer to a hydrostatic test pressure which will produce in the pipe, at room temperature, a stress of 90 percent of the specified minimum yield strength. This pressure shall be determined by the formula:

$$P = 2st/D$$

where:

P = minimum hydrostatic test pressure, psi
s = 90 percent of the specified minimum yield point
t = actual wall thickness
D = outside diameter of the pipe.

The test shall be maintained for not less than 5 min.

7) Flattening test on pipe intended for bending or forming shall be made in accordance with Paragraph S 3 of ASTM A362.

8) Minimum wall thickness of the casting shall be determined by the same formulas governing that of wrought steel pipe, except that the permissible stress values shall be as shown in the appended table.

9) The foregoing requirements establish interim provision until such time as further ASTM specifications on centrifugally cast pipe, which the committee understands are in preparation, become available and are accepted by this committee.

Table 1 lists the maximum allowable stress values in tension for centrifugally cast steel pipe.

TABLE 1—MAXIMUM ALLOWABLE STRESS VALUES in tension for centrifugally cast steel pipe presented below. Values are given in pounds per square inch

Material and specification number	Grade	Tensile strength minimum	Yield strength minimum	For metal temperatures not exceeding F deg									
				−20 to 100	200	300	400	500	600	650	700	750	
Carbon steels A216	WCA	60,000	30,000	16,900	16,400	15,800	15,200	14,650	13,500	13,500	12,900	11,650	
	WCB	70,000	36,000	20,250	19,500	18,750	18,000	17,250	16,500	15,750	14,950	13,300	
Low alloy steels A217	WC1	65,000	35,000	19,500	18,700	17,900	17,100	16,250	15,450	14,650	14,650	14,650	
	WC4	70,000	40,000	21,000	20,150	19,250	18,400	17,500	16,650	15,750	15,750	15,750	
	WC5	70,000	40,000	21,000	20,150	19,250	18,400	17,500	16,650	15,750	15,750	15,750	
	WC6	70,000	40,000	21,000	20,150	19,250	18,400	17,500	16,650	15,750	15,750	15,750	
	WC9	70,000	40,000	21,000	20,150	19,250	18,400	17,500	16,650	15,750	15,750	15,750	
	C5	90,000	60,000	27,000	25,900	24,750	23,650	22,500	21,400	20,250	19,450	18,350	
	C12	90,000	60,000	27,000	25,900	24,750	23,650	22,500	21,400	20,250	19,800	18,900	
High alloy steels A351	CA15	90,000	65,000	27,000	25,700	24,450	23,200	21,950	20,700	19,450	18,650	17,650	
	CF8	70,000	28,000	15,750	14,850	13,950	13,050	12,150	11,250	10,350	10,150	10,000	
	CF8M	70,000	30,000	16,900	16,350	15,800	15,200	14,640	14,100	13,500	13,250	12,900	
	CF8C	70,000	30,000	16,900	15,850	14,800	13,800	12,750	11,750	10,700	10,550	10,450	
	CH20	70,000	30,000	16,900	16,250	15,600	14,950	14,300	13,600	12,950	12,900	12,850	
	CK20	65,000	28,000	15,800	15,350	14,850	14,400	13,900	13,450	12,950	12,900	12,850	

For metal temperatures not exceeding F deg														
800	850	900	950	1000	1050	1100	1150	1200	1250	1300	1350	1400	1450	1500
9,700	7,800	5,850	4,050	2,250										
10,800	8,350	5,850	4,050	2,250										
14,100	12,950	11,250	9,000	5,650										
15,300	14,200	12,600	9,000	4,650										
15,300	14,200	12,600	9,900	7,000	4,950	3,600								
15,300	14,200	12,600	9,900	7,000	4,950	3,600								
15,300	14,200	12,600	9,900	7,000	5,200	3,800	2,700	1,800						
17,100	15,300	12,250	9,000	6,600	4,700	3,000	2,000	1,350						
17,450	15,600	13,500	10,600	7,650	4,950	3,000	2,000	1,350						
16,500	14,400	9,900	6,850	4,500	3,000	2,000	1,350	900						
9,800	9,600	9,350	9,100	8,850	8,650	6,750	5,200	4,050	2,950	2,200	1,600	1,250	900	700
12,600	12,150	11,700	11,100	10,550	9,550	8,450	7,200	6,100	4,750	3,600	2,700	2,100	1,650	1,350
10,350	10,200	10,100	10,000	9,900	9,800	9,700	7,200	4,500	3,250	2,450	1,800	1,400	1,100	900
12,750	12,500	12,150	11,250	9,450	7,650	5,850	4,500	3,400	2,600	2,100	1,600	1,150	800	700
12,750	12,500	12,150	11,250	9,900	8,800	7,650	6,550	5,400	4,300	3,150	2,100	1,450	1,000	700

Note: The above stress values include a casting quality factor of 90 percent.

Sam Lewis' Page

How *Not* to Design Plant Cooling

I VISITED, during the 1958 sub-zero attack, two industrial plants. In plant No. 1 the air supply systems are suspended between the roof trusses. Each of many units has an intake through the roof. Dampers admit air either from the outdoors or alternately provide recirculated air at truss-bottom level.

Each supply system delivers air through radiating ducts to several diffusers at truss-bottom level. Air exhausted by process-exhaust presumably is replaced by outdoor air.

The air supply filters are of the throwaway cell type. When they become clogged with dust (this, at the time, was converted to mud by snow) the passage of air is reduced greatly.

To do anything about this unhappy situation, one must climb (precariously) a vertical ladder to a platform alongside the clogged filter cells. He must pull out several of them, lower them by rope to a helper 20 ft below, and pull up replacement cells. This filter changing job is an unpopular one, and I deduce that it is put off as long as possible —perhaps until the filter media has been disintegrated and torn apart by the air pressure.

Another noticeable shortcoming of the installation was that, during the severe cold, serious frost damage occurred to the heating coils.

In plant No. 2, comparable in size with plant No. 1, there are about 25 enclosures *above* the roof. Each enclosure covers one air supply system and a commensurate air exhaust system. The pipes and ducts for air distribution into the building are between the trusses and below the roof.

There is a convenient walk-through door above the roof into each enclosure, all accessible by waterproofed plank walkways over the gravel on the roof. Every air filter can easily be replaced, and the ease with which fan and motor bearings can be lubricated is commendable.

As viewed from an airplane, the roof of plant No. 1, with its forest of various shaped air intake and air exhaust hoods, was a discouraging sight. A similar look at the roof of plant No. 2 was appealing, since the enclosures, about 6 ft above the flat roof, are free of hoods and humps.

The offices in both of these plants are said to be air conditioned. Both have refrigerating plants that deliver refrigerant to rust resistant, heat absorbing coils in the air stream.

In plant No. 1 the supply fan delivers air to several long sheet metal trunk ducts that are above corridor ceilings and furnish air to groups of private offices. The temperature of this air in one of the ducts is regulated by a single thermostat in room No. 3, one of eight similar offices.

There is a continuous pipe coil radiator along the window side of all eight private offices whereby the flow of hot water may be reduced for the whole line. This is controlled by one valve in room No. 8. The radiator passes through a slot in each partition between the offices. Control of the air supply for all eight offices is in room No. 3, and the valve on the radiator for all eight is in No. 8.

The important occupant of room No. 5 receives frequent visitors and sometimes his office is overcrowded. The thermostat in room No. 3 dictates that air shall enter No. 5 at 70 F to suit the desires of the ailing occupant of No. 3. However, air at 70 F does not keep the busy executive and his guests in office No. 5 at anywhere near cool comfort.

The secretary in room No. 8 is prone to wear lightweight clothing and insists on the beneficial warmth emanating from the hot water pipes below the windows. The long suffering inhabitant of room No. 5 thus is plagued by overheating.

The only help obtainable for room No. 5 is for Mr. Big to run to room No. 3 and change the thermostat — resulting in delivery of too much cool air to rooms 1, 2, 4, 6, 7, and 8 —and then to dash to room No. 8 and close the valve on the hot water pipe coils — resulting in further cooling to those rooms. The secretary in room No. 8 then went home.

The cooled hot water coils ceased to prevent the downdraft from the windows, and could not overcome the entering 60 F air supply.

Let my protest here be registered against the designer of this ailing plant for his failure to insist that a thermostat must control *both* principal sources of heat and heat removal for each room. The objectionable zone control for the group of offices should be abolished. The temperature of the air admitted to *each* office shall be controlled.

In plant No. 2, to the contrary, the thermostat on the wall of each private office controls the air delivery temperature in both winter and summer, and also closes and opens the radiator valve in that room. ∓

SAMUEL R. LEWIS, *consulting mechanical engineer and a member of Heating, Piping & Air Conditioning's board of consulting and contributing editors, comments informally each month on practical problems in the field.*

The Law and Your Profits

BY WILLIAM HURD HILLYER

Buyer Must Fix Blame for Defects

THIS CASE should clarify the possibility of recourse for defects, hidden or otherwise, in newly purchased equipment. The manufacturer's risk by reason of implied warranty is also clearly exemplified.

Hotkuhl Air Conditioning Co., Inc. sold an air conditioning unit to A. Deelah. He immediately resold it to a tourist court owned and operated by Bonny Face. One of Bonny's employees drove to Hotkuhl's office and picked up the unit. After seeing that it operated properly, he took it back to the tourist court where it was installed.

This happened on July 6. Two days later Bonny Face phoned Deelah to advise him that a tube was damaged and that he wanted it repaired.

Deelah informed Hotkuhl of what had occurred and that firm sent a service man employed by Skilworth Service over to fix it.

Deelah asked the city court to make Hotkuhl take back the unit and refund the purchase price.

In court the service man testified on behalf of plaintiff Deelah that "the return lines going to the compressor had broken" because "the unit should have been bolted down in shipment."

On his visit the mechanic had repaired the broken line. While he was recharging the unit with refrigerant "the motor stopped. The circuit breaker had tripped since the line was overloaded. They should have had separate circuits," he said.

Another mechanic employed by the service company testified that before Hotkuhl sold the unit he himself had repaired and serviced it and seen that it was operating according to specifications. The court of appeals made the observation that he knew, as did the first mechanic, that the tourist court was not properly wired for the unit.

Peter Knowitt, who handled the purchase for Deelah, stated in the city court that he was "thoroughly familiar with the details of the transaction." He said that he purchased the unit on July 3 and, in behalf of Deelah, sold it to Bonny Face.

On July 13 he learned from Bonny Face that the service man had been to the tourist court. When the service man had tried to operate the unit it would actuate the circuit breaker, Knowitt stated. "It was for that reason that the service man had suggested that the unit be moved to a fused circuit. On August 19 I was informed by Bonny Face that the unit was blowing fuses after 2 or 3 minutes of operation."

Not until September 4, Knowitt further testified, did he inform Hotkuhl that the motor was burned out.

John Hotkuhl, president of the defendant company, testified that the unit was checked and serviced by the Skilworth firm before it was sold to plaintiff Deelah, and that it was operated in the presence of the tourist court truckman, who called for it. In addition, a Hotkuhl employee stated that he "saw the unit running" before it was picked up.

The city court refused to give Deelah a judgment, so he carried the case to a higher court.

The court of appeals saw only a question of fact as posed for its consideration; to wit, was the motor burned out before the sale to plaintiff Deelah, thus permitting him to maintain successfully an action of redhibition? The court then cited one of its own recent decisions:

"There exists in every sale . . . the seller's warranty against hidden defects in connection with the article of merchandise sold. . . However, the civil code expressly places the burden of proof on the buyer to establish that the defect existed before the sale to him."

The higher court found that the plaintiff Deelah had offered no evidence to establish as a fact that the unit's motor was not operating at the time of the sale, nor that the motor had burned out within three days following the transaction.

On the contrary, testimony indicated that the motor was operating several weeks after it was in possession of the tourist court, and that it ceased operation because the electric current was overloaded with other devices. In view of these conditions the court of appeals affirmed the city court's judgment in favor of Hotkuhl.

It was fortunate for Hotkuhl that, by statute, the burden of proof rests on the buyer. He faced the principle of seller's warranty against hidden defects. His care in protecting his company against the hazard of such warranty and such defects was rewarded. ≠

WILLIAM HURD HILLYER, *author of this regular feature, is a contributor to a number of banking and financial publications and has written several books on business. He has an extensive practical legal and financial background.*

This series presents actual cases. All names are fictitious. It should be remembered that laws vary in different states.

How to Convert Free Air Volumes To Compressed Air Equivalents

BY J. F. WATERS
Assistant Design Engineer
Ewbank & Partners, Ltd.
Consulting Engineers

ENGINEERS dealing with compressed air are frequently faced with the necessity of converting air at *as compressed* volume, pressure, and temperature into equivalent cubic feet of *free* air, and vice versa. *Free* air is air at 14.7 psia and 68 F at a given volume.

The basic formula for the conversion is:

$$P_a V_a / T_a = P_b V_b / T_b$$

where:

P_a, V_a, and T_a = original pressure, volume, and temperature, respectively, absolute
P_b, V_b, and T_b = final pressure, volume, and temperature, respectively, absolute.

In practical use this formula may be written:

$$Q = [528\ V_1(P_1 + 14.7)]/[14.7(T_1 + 460)] \quad \text{..... [1]}$$

where:

Q = volume of free air, cu ft
V_1 = volume of *as compressed* air, cu ft
P_1 = pressure of *as compressed* air, psig
T_1 = temperature of *as compressed* air, F.

Conversion using this formula often represents irksome calculation. The nomograph on the next page eliminates this calculation to give quick solutions.

How to Use Chart

In most cases, when the *as compressed* air exists at temperatures close to 68 F, it is practicable to ignore temperature effect when converting to free air, and vice versa. When this is the case, use is made only of the V_1, P_1, and Q scales.

If, however, a temperature correction is required, this can be achieved by using the T_1 and Q_{T1} scales to give a modified value of Q corrected for temperature.

Example 1

Problem: An air receiver has a volume of 8 cu ft and contains air at 120 psig and 68 F. What is the content of the receiver in cubic feet of free air?

Solution: Join 8 cu ft on the V_1 scale to 120 psig on the P_1 scale. The point of intersection on the Q scale gives the solution as 73 cu ft of free air.

Example 2

Problem: Suppose the same conditions exist as in Example 1, except that the air temperature is 150 F. Again, what is the content of free air?

Solution: Proceed as in Example 1 to obtain Q. Connect the value of Q to 150 F on the T_1 scale. The point of intersection on the Q_{T1} scale gives a corrected-for-temperature solution of 63.5 cu ft of free air.

Reverse Procedure to Find Compressed Air

To convert free air to compressed air, ignoring temperature correction, start with Q and select a desired value of P_1 or V_1. The point of intersection on the scale for the unknown gives the solution, whichever unknown it may be.

If a temperature correction is to be made, start by pinpointing Q on the Q_{T1} scale. Connect this point to T_1 and intersect Q at a modified value. P_1 or V_1 is then obtained as before.

This is illustrated by considering Examples 1 and 2 in reverse.

Example 3

Problem: What volume of compressed air at 120 psig and 68 F is equivalent to 73 cu ft of free air?

Solution: Connect 120 psig on the P_1 scale to 73 cu ft on the Q scale. This intersects the V_1 scale at 8 cu ft.

Example 4

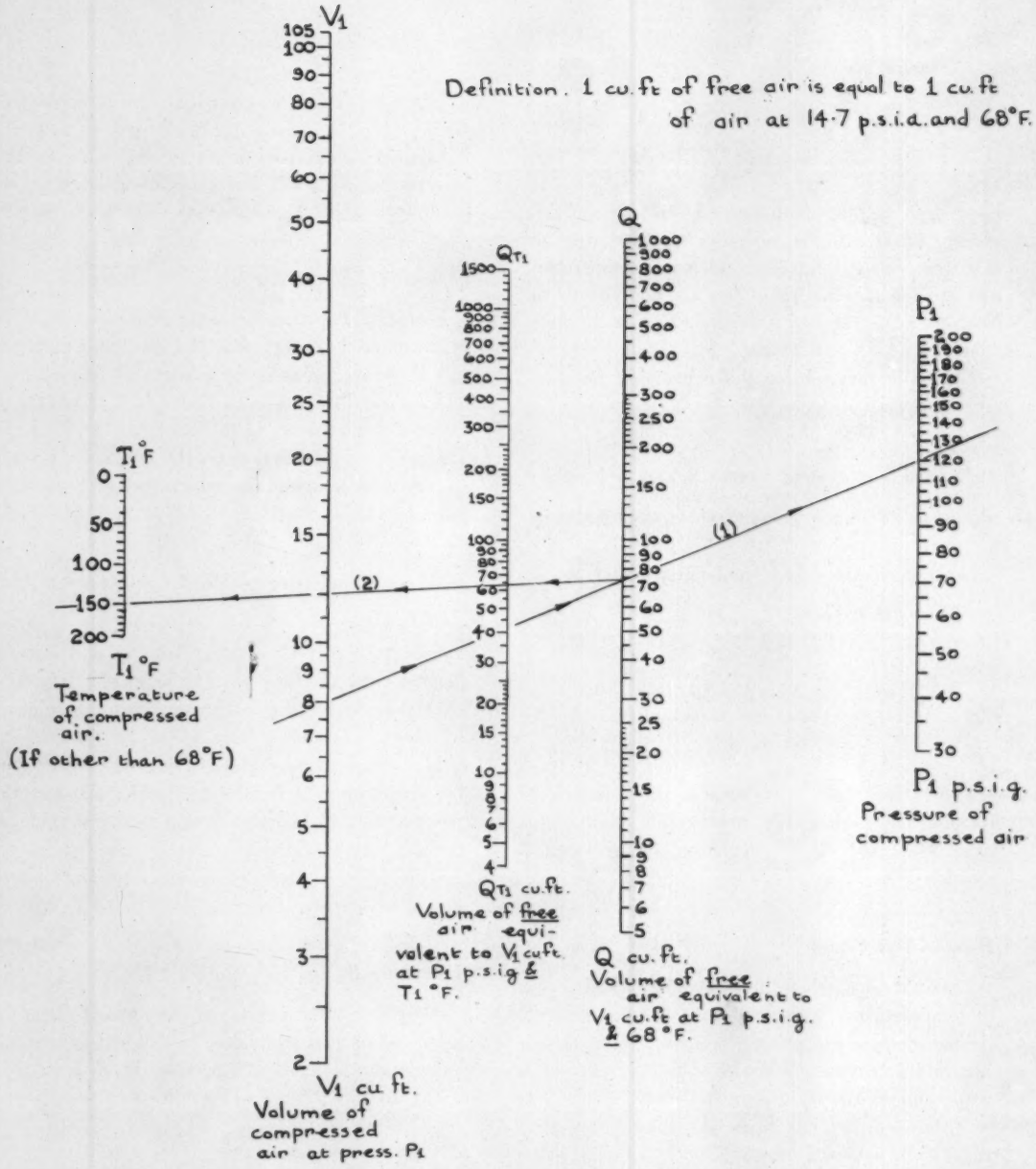
Problem: What volume of compressed air at 120 psig and 150 F is equivalent to 63.5 cu ft of free air?

Solution: Connect 150 F on the T_1 scale to 63.5 cu ft on the Q_{T1} scale. Connect the point of intersection on the Q scale to 120 psig on the P_1 scale to interest the V_1 scale. The answer is given again as 8 cu ft.

This is a second Data Sheet by the author. In the February issue a valuable shortcut to finding pressure drops and selecting best pipe sizes for compressed air piping was presented.

Tear out along this line

HPAC DATA SHEET



CONVERSION of free air quantities to compressed air equivalents, and vice versa, is simplified by use of this nomograph. Chart is based on conversion formula. How to use it is explained on preceding page

HEATING, PIPING & AIR CONDITIONING

JOURNAL SECTION

OF

AMERICAN SOCIETY OF HEATING AND AIR-CONDITIONING ENGINEERS

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President's Message

Premises for ASHAE-*ASRE* Merger

I believe it is of interest to all members to learn the chief premises used in drawing up the plan for the proposed merger of ASHAE and ASRE.

First of all, the Headquarters would continue to be maintained in New York City, and in the New United Engineering Center, when that building becomes available. It is presumed that the initial membership of the merged society would be at least 15,000 in all grades. Basic dues for a full member would be $25.00 per year.

The following publications will be available to the members:—

1. Guide or Handbook
2. Journal
3. Transactions
4. Membership Roster

An extensive research program similar to that now conducted by ASHAE would be carried out by the merged Society, with a portion of membership dues allocated to research. The research program would receive additional support from the exposition which would continue to be held on a biennial basis, with the net proceeds accruing to the Society being allocated to the Research Program.

The Society would continue to conduct a comprehensive program in the development of codes and standards, as now carried out by ASRE.

The merged Society would furnish financial support to local groups, similar to the present practice of ASRE, and so established as not to interfere with the current practice of having local group dues as now done by ASHAE; this to be at the option of the local groups. The Council of the Society may fix a ceiling for local dues and also may establish a maximum of local group financial reserves.

All these premises are subject to review by the Councils of the two Societies and may be amended before the plan is presented to the membership.

E. R. Queer

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Information on other Society personnel can be found on page 171.

Educator's View of Need for Good Classroom Environment

By

G. B. Wadzeck

The author is Superintendent of Schools, San Angelo Public Schools, San Angelo, Tex. A presentation at the Symposium on School Heating, Ventilating and Air Conditioning at the 64th Annual Meeting of the American Society of Heating and Air-Conditioning Engineers, Pittsburgh, Pa., January 29, 1958.

To recognize the need of improved classroom environment, one must first analyze the changing role of education as the way of life changes. Few people will face up to the needs of the schools, unless they are shown complete justification for the suggested changes. Let us briefly examine changes in the way one lives to see if additional consideration for improved classroom environment can be justified.

In the history of the development of man, the physical man and his needs have been predominantly in the majority. At the beginning of this century, only 4 percent of the total population was completing high school. The role of the school was a simple process — teach simple arithmetic, teach the reading process and include sufficient writing ability for simple communication, and the needs of a very large percent of the students were met. The small percent graduating from high school and going on to college needed a very simple curriculum of college preparatory for professional training.

We are now in a stage of transition from the physical man to the development of the trained mind. It has been estimated that within the next 7 years, the need for physical labor will decrease by 50 percent and that the need for properly trained people will increase by 50 percent. To project this 10 years deeper into the future, one sees a world which will need many professionally trained people, with a second group having semi-professional training, and possibly a small third group with training in menial occupations. There will be little or no place for the common laborer.

Now let us examine the effects of this change which is taking place. The amount of knowledge presently available, which must be transferred to the youth before they reach a point of productivity, is 3 or 4 times as great as it was at the beginning of this century. Within the next 10 to 15 years, the quality and quantity of knowledge will increase 2 to 3 times over the present requirements.

On analyzing the product of the public schools, one will find that the lower primary grade child will require approximately 20 years of education and training before reaching a point of productivity. Who should teach the child, what should he be taught, and how efficiently should he be taught now in order to reach a point of productivity in 1980 — these present a very startling challenge. Try to visualize what the world will be like in 1980 and one will see the present challenge of education.

In the lifetime of some of our citizens, we have moved in the field of transportation from the horse and buggy to the very brink of an age of space travel. Since the launching of Russia's first satellite, one has witnessed many mixed emotions concerning the educational program.

It is not uncommon to hear people say that they simply cannot afford to provide the type of educational program needed and continue to educate all of the citizens.

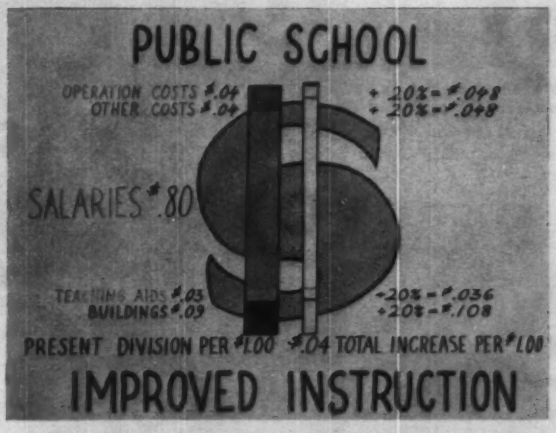

Fig. 1 — With 80 cents of every school dollar going for salaries, 20 percent increase in the other costs results in 4 cents increase per school dollar

If the situation is thoughtfully examined, the conclusion will be that we dare not do less. If we only provide for the top ability groups, we are inviting the death blow to our way of life. We will be providing for a minority whose leadership will be defeated by a majority at the polls to create some kind of an *ism*, possibly more drastic than socialism or communism.

One needs to evaluate thoughtfully the national expenditures. Statistics show a misplacing of values. Nationally, we spend more on either cosmetics, tobacco or alcohol than the combined expenditures of our educational and church activities. The author believes this example alone will kill the radical comments that we are about to bankrupt ourselves in expenditures for education. The author has confidence that the people of this nation will provide the necessary funds to provide adequately for the children.

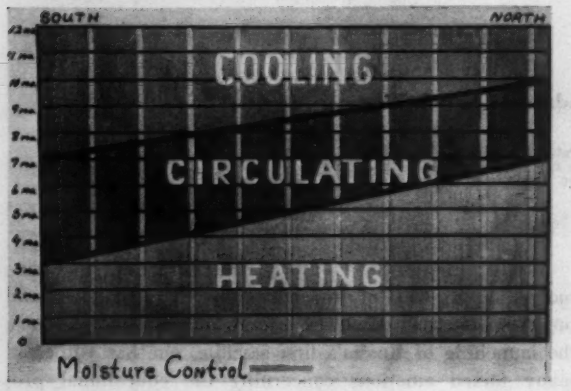

Fig. 2 — Variation of need for air-conditioning functions between northern and southern localities

could be done by nonprofessionally trained people. Secondly, there is a need to provide the many teaching aids and materials, also the many electronic devices, such as television, radio, tape recorders and projectors, so that each teacher may teach more children with a higher degree of efficiency than at present. The third discrepancy which must be corrected involves the physical comforts necessary for a high degree of efficiency. This will be accomplished through the use of year-round air conditioning. We are proposing that the educational dollar be redeployed; with slight additional increases, we can bring about proper efficiency to teach the child.

Time will not permit discussion on the total changes needed. We are delineating in our remaining time a discussion of the need for year-round air conditioning. It is very important that we discuss the fundamentals of total

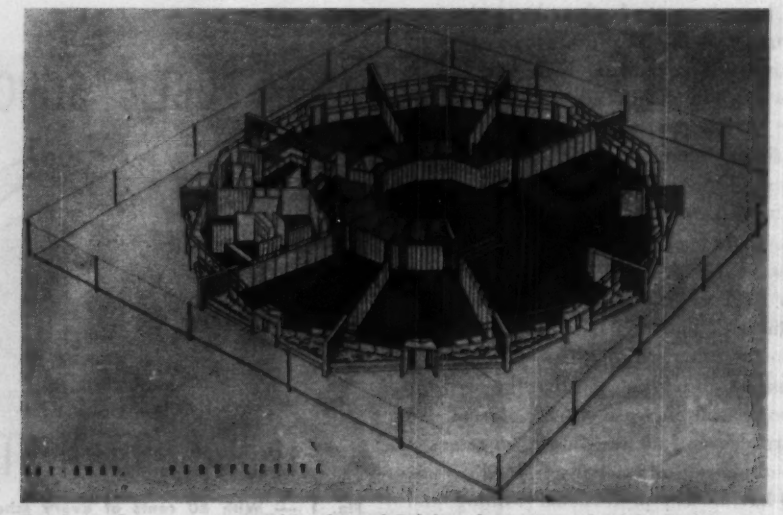

Fig. 3 — Cut-away perspective view of Belaire elementary school in San Angelo, Tex., completely air conditioned

The responsibility of educators rests in properly evaluating the educational dollar. To assure the people of the full dollar value for each dollar expended, we must examine the expenditures of the public schools. We will find that 80 cents of each dollar spent goes to salaries (Fig. 1). If we increase all expenditures in the schools by 20 percent, we will only increase the total dollar expenditure from $1.00 to $1.04. If we are to stretch the educational dollar, it must be through the better utilization of our professional educators. In simple terms, we are saying that we want more mileage out of each professional teacher and we are asking the question — what needs to be done to secure this mileage?

Many things are limiting the efficiency of the teacher. First, there is the tremendous load of clerical work which

Fig. 4 — One of the classrooms in the Belaire air-conditioned elementary school

air conditioning, so that the average educator, board member and general layman understand this total significance.

Too many people think of an air-conditioned school as one with some system of lowering the temperature when it is too high for maximum efficiency. We are too prone to accept as satisfactory a building which is not too cool for proper efficiency. Nature chills the air; at certain times of the year it becomes too cold for physical comfort and efficiency, and needs to be balanced by conditioning the air with heat. In the same way, nature gives off excess heat which needs to be cooled. These two steps in air conditioning are obvious.

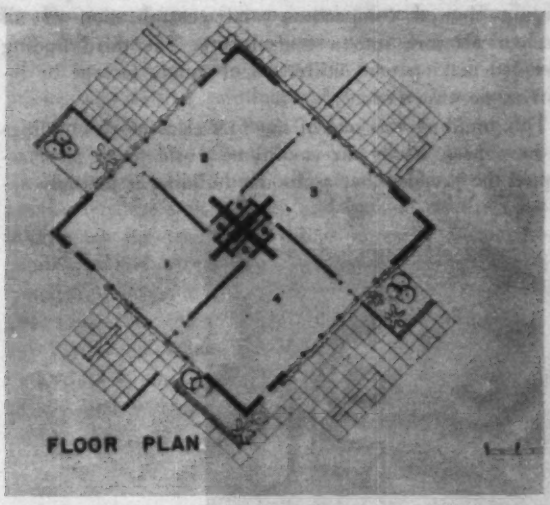

Fig. 5 — Square building with 4 classrooms and central core for all services

To a lesser degree, it is recognized that the air is too moist and needs to be dried; that air becomes stale and needs to be circulated; and that in the process of circulation, the air needs to be filtered to free it of dust, dirt and pollen in order to produce a healthful environment.

One item concerning air conditioning, which has received little recognition, is the effect of rapidly changing temperatures. It has been proved many times that on a cold day, with the children out of the classroom on the playground or in the gyms, the empty room establishes a temperature of 71 or 72 F, and when the children return to the room, body temperatures increase the room temperature by 10 to 12 deg. in approximately 4 min. If a system does not provide for artificial circulation of outside air, the windows will be raised, and the room temperature may drop to 50 F or less before it is noticed by teacher or student. The children become sick, and we are wondering why. I doubt that you would find a great many educators who have analyzed this situation; it is the professional responsibility of the engineers to see that they do understand this total problem of air conditioning.

The Southern States have long constructed school buildings at a lower dollar cost than the North. This is largely due to the climatic conditions and the provision of only limited heating facilities, rather than total air conditioning. The mechanical cost of construction should be fairly consistent throughout the nation (Fig. 2).

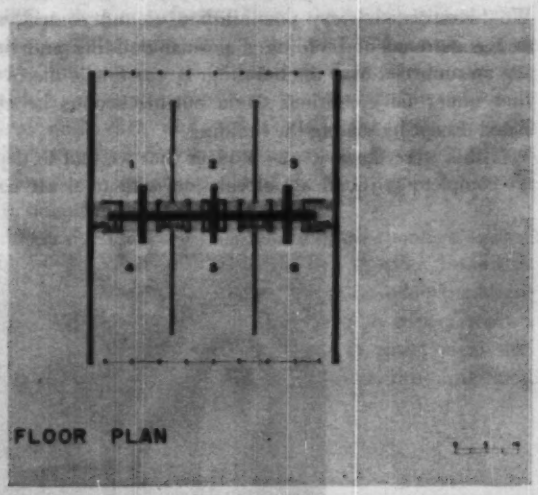

Fig. 6 — Back to back arrangement of 6 classrooms with central core for services. Two such buildings are in planning stage in San Angelo

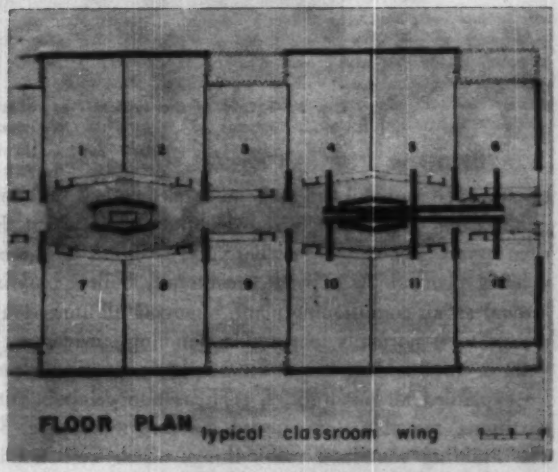

Fig. 7 — Typical classroom wing of air-conditioned, 2000-pupil high school in San Angelo

With total air conditioning, the cooler climates will provide heavier heating equipment with lighter chillers, but with equal artificial circulation and air control. The warmer climates will provide heavier chilling equipment with lighter heating equipment, but with equal circulation and purification facilities. This balance is an absolute must

to provide the educational atmosphere necessary for top efficiency in the classrooms.

We were very fortunate in San Angelo, Tex., in being confronted with a serious sound problem. It was necessary to build an elementary school very close to an air base. We investigated every possibility of sound control, even to the extreme of building a normal building and building an umbrella over the building. It was finally discovered that under no conditions could outside sounds be eliminated except by sealing the building.

If this were done, it was obvious that we had to depend on complete artificial air circulation with total air conditioning. We were planning 4 other elementary buildings at the same time and realized that the cost factor at this elementary school had to be very close to the other 4 being planned. As a result, we literally built a building around an air-conditioning plant, removing all unnecessary expenditures normally incurred in handling outside air.

Since this building was to be completely air conditioned, we expanded all possibilities, such as non-weight-bearing partitions, movable storage, and movable walls (Fig. 3). The building contained many things which were not included in the other buildings (see Fig. 4). By examination of the two exhibits, one can see the short duct runs, the flexible walls, the movable storage, and the many other aspects which contributed to a stronger educational environment for the child.

By any means of comparison, the Belaire school compares favorably with the other 4 buildings. It was a much improved educational tool and was cheaper per square foot than 3 of the other buildings, and only slightly higher per square foot than the fourth building.

The cost factors, by comparison of the 5 buildings, led us into a complete investigation of why. This resulted in a few very definite findings. A more compact building with less outside wall surface would build more economically than a finger type. With the traditional things normally included as necessities without air conditioning eliminated, the second and probably the most important finding showed compactness and centralization of all mechanical work into a central core. The third finding included making total utilization of square footage by incurring no wasted space.

This building was one of the first elementary buildings to have been totally air conditioned, and many have accepted the premise that a circular building is the only approach to economy in an air-conditioned building. The circular pattern is very desirable; however, it does have one disadvantage — it is very difficult to add to, and to increase the size it would be necessary to work in modules of similar size. In analyzing this problem, we have discovered that a square building (see Fig. 5) provides a central core for all plumbing and mechanical work, and a minimum outside wall area. A domino type, back to back classroom (see Fig. 6) would provide a similar central core and could be extended to almost any size building. We now have two elementary schools on the drawing boards patterned after Fig. 6.

The results obtained from the construction of the small elementary school led us to plan a 2000-pupil high school completely air conditioned. A typical classroom wing is shown in Fig. 7. A double loaded corridor type was selected. Notice the shift in use of square footage. Two classrooms are carried to the eave of the roof with solid brick walls. Each third classroom is inset to narrow the hall and to create protection for glassed areas.

A chilled water secondary system of air conditioning was used, with a mechanical well in a widened area of the

Fig. 8 — One of the typical classroom wings under construction with air-conditioning ducts in place

hall to provide short duct runs and concentration of utilities. This created a very pleasing effect by breaking up the long, institutional hall effect normally found in large schools. The cost factors of this building will compare favorably with any secondary building being constructed in this general area of San Angelo, Tex.

Fig. 8 shows one of the classroom wings under construction. The air-conditioning ducts can be observed, and solid brick walls with a minimum of outside glass and with non-weight-bearing partitions.

The implications of our experience with total air conditioning indicate that one can construct a building for approximately the same money and include total air conditioning, as the traditional things normally included are eliminated and proper utilization is made of the square footage. A second major implication is that the additional utilization cost will normally be offset by savings in janitorial personnel, waxes and cleaning fluids. Our experience shows that a janitor can maintain from 25 to 50 percent more square feet in a sealed, totally air-conditioned building than he can in an open traditional building. The engineers have estimated the utility cost in the high school to be $10,000 more with total air conditioning than it would be in a traditional building. By janitorial personnel handling 25 percent more square footage, we will save $15,000 a year on salaries. Third, the building is at equal efficiency 12 months out of the year, 24 hours a day. Fourth, the educational atmosphere is tremendously improved. Even temperatures the year-round, filtered air to remove dust, dirt, and pollen place the child and the teacher at top efficiency throughout the day and find that they are less tired at the end of the day than when working in other buildings.

Student attendance in this building has averaged from 3 to 8% better due to less sickness than in other buildings.

In summary, if we are to improve the educational environment in the classroom, if we are to expect top efficiency from our teachers, if we are to make maximum utilization of our buildings, total air conditioning is a must in the school of tomorrow.

CORROSION ACTIVITIES

In reply to a request from the Inter Society Corrosion Committee for information as to ASHAE activities on corrosion problem, F. N. Speller, Pittsburgh, Pa., informed the Committee that the Society has not yet started actively working on finding answers to various corrosion problems which are of interest.

It was also stated that among such corrosion problems is that of protecting piping systems when anti-freeze solutions are used. It was suggested that the Society would consider cooperation with any experienced group in studying this problem.

The Inter-Society Committee is sponsored by the *National Association of Corrosion Engineers* and Dr. Speller is the ASHAE representative on the Committee.

PLAN FOR MORE ENGINEERING TEACHERS

In a recent issue of the *Newsletter*, issued jointly by the Engineering Manpower Commission of *EJC* and Scientific Manpower Commission, highlights of a plan to encourage more engineering students to enter graduate study are outlined. The plan was presented to Dr. J. R. Killian, Jr., the President's Special Assistant for Science and Technology by *ASEE*. It is hoped that the ultimate result of the plan would be an increase in the supply of teachers of engineering. The four-point plan is outlined in the following terms: (1) a substantial increase in the number of *National Science Foundation* fellowships for first-year graduate study in engineering; (2) a program of secondary grants to those who fail to qualify for full fellowships under the *National Science Foundation* program; (3) supplementary federal grants to holders of *National Science Foundation* fellowships who take part-time teaching assignments; and, (4) a new program of awards under the *National Science Foundation* to increase the financial aid to graduate students who combine teaching with their education and research experience.

ASEE also called attention to the important role of basic research in preparing engineering teachers. It was also indicated that until substantial steps are taken to relieve the critical shortage of teachers, efforts to increase undergraduate enrollments are highly questionable.

SANFORD RETIRES

Following 30 years of service with Detroit Edison Co., S. S. Sanford, long-time Society member and supervisor of steam sales retired on March 1st. Mr. Sanford joined the Edison Co. in 1919 and most of the time since that date he has been spending in connection with various aspects of the engineering work of the Central Heating Department.

Mr. Sanford is a past president of the Michigan Chapter of ASHAE, member of *ASRE*, and past president of the *National District Heating Association*. No word has been received as to Mr. Sanford's plans for the immediate future.

Attention!!
Members of ASHAE
Moved or Moving?

Each month mail is returned BECAUSE you overlooked advising us of the change in your address.

In your own interest, will you please advise us at once of any change in your business or home address, indicating which is your mailing address.

ASHAE Headquarters
62 Worth St.
New York 13, N. Y.

RECENT COUNCIL ACTIONS

Among the important matters covered at the 2 recent meetings of the Council held just before and just after the Annual Meeting in Pittsburgh were the following, believed of general interest to the membership • • • the word *standard* is to be used in future standard work and the word *code* is not to be used • • • R. A. Sherman, Columbus, Ohio, M. F. Blankin, Philadelphia, Pa., E. F. Snyder, Jr., Minneapolis, Minn., and H. A. Lockhart, Morton Grove, Ill., are a sub-committee of the Building Committee to investigate a site or sites for a new laboratory building • • • an award to be known as the ASHAE Life Members Award is to go to a member who has done outstanding work in education • • • a new special committee — the Educational Committee — is being appointed to develop a program to attract manpower to the profession; members are John W. James, Chicago, Ill., F. H. Buzzard, Philadelphia, Pa. and P. B. Gordon, New York, N. Y. • • • ASHAE will contribute to the support of International Institute of Refrigeration during the present year • • • the President was authorized to establish a Committee on Society and Industry History.

Economic Evaluation of High-Temperature Water

By

E. M. Thompson

The author is an independent consultant, Washington, D.C. A presentation at the Symposium on High-Temperature Water at the 64th Annual Meeting of the AMERICAN SOCIETY OF HEATING AND AIR-CONDITIONING ENGINEERS, Pittsburgh Pa., January 28, 1958.

ALL OF US are interested in one objective, namely, to find the most economical way of transferring a given amount of heat from source to user in a given time.

Unfortunately, it is not easy to place a dollar and cents value on some of the factors which affect the choice of a heat transfer system. There is, of course, fuel economy which is fairly easy to determine, but how much is it worth, for example, to use a system for which both operation and maintenance requires lower norms of intelligence and training? Or where a shutdown can be repaired in less time? Or what is the useful life of the system and of its components?

There are also many mediums by which heat may be transferred besides steam and water, such as air, sodium and electricity. However, for present purposes let us restrict ourselves to steam and water and endeavor to make a broad brush cost comparison of steam with high-temperature water.

Heat Extraction

Before going any further, it seems desirable to make a quick comparison of the two systems from a Btu extraction point of view. In several instances, the writer has seen the comparison made between the Btu content of a cubic foot of steam and the Btu content of a cubic foot of high-temperature water. This may be a good sales talk, but is misleading and unnecessary, as high-temperature water can stand on its own feet. The comparison is misleading because steam can be transmitted at 10 times the velocity of water. Furthermore, the Btu content of the steam condensate is less than that of the high-temperature return. So, pound for pound, approximately 8 times as many Btu are extracted from steam. Even so, it can be easily shown that for a 375 deg F condition the same size supply line will deliver twice as many Btu using high-temperature water as steam at the corresponding pressure. To put it another way, a 6-in. high-temperature water supply line will deliver as many Btu as an 8-in. with steam. However, the return high-temperature water line must also be 6-in., whereas the return condensate line can be 3 to 4 in. Considering the amount of water lost through the necessary traps in a steam system, a 3-in. return line would probably suffice.

Heat Production and Distribution

Now let us consider the Power House. Almost any ordinary type of steam boiler can be used for high-temperature water provided it is of the large tube type. This type boiler has the added attraction that, if the steam drums are sufficiently large, the expansion and contraction of the return high-temperature water, due to temperature changes, can be accommodated without the use of a separate expansion chamber. Also, if so desired, steam may be drawn from the boiler for process use. Express type boilers with superheat can be used by utilizing a rather costly spray type converter to convert the steam to high-temperature water. The drowned type of boiler or high-temperature water generator is sometimes provided with forced circulating pumps and, of necessity, an expansion tank or drum. This expansion tank is an added cost and complication. This is particularly true when the expansion tank is on the discharge side of the generators requiring either that the tank be elevated to assure positive suction to the main circulating pumps or a by-pass must be provided from the return high-temperature water to prevent flashing in the pump suction. These costs and complications can be greatly reduced by placing the expansion tank and pumps on the return side of the high-temperature water generators. Due to the diversity factor and the flywheel effect of the heat stored in the high-temperature water system the size of the boilers for high-temperature water can be reduced by at least 20 percent of that for steam. The writer believes this is a conservative figure but pending more information, would be loathe to go beyond it.

The high-temperature water system of necessity must have large main circulating pumps. However, the head against which these circulators pump is primarily only the resistance head. This cost is offset by the boiler feed pumps, deaerators, feed heaters and condensate return pumps necessary in the steam system.

In a steam plant there is always a make-up feed problem and the attendant water treatment. These are practically eliminated in the high-temperature water system.

Already touched upon is the subject of the relative sizes of the supply and return lines of the two systems. Cost-wise, the increased size of the steam supply is offset by

the reduced size of the condensate return. This, however, is only a part of the answer. Steam lines must be carefully graded to insure drainage and traps are installed at each low point of the line. To service these traps it is either necessary to have steam lines above ground or, if underground, conduits, or at least manholes must be provided. There is also the constant danger of water hammer. On the other hand, the high-temperature water distribution lines can be installed underground conforming to the general contour of the land without manholes or traps. Air vents are sometimes placed in the high points of the high-temperature water distribution lines, but the writer is not convinced they are necessary.

Installation Costs

From an installation cost point of view, the high-temperature water is at its greatest disadvantage when reaching its end use. Here a pressure reducing valve-desuperheater complex must be replaced with a converter which converts the high-temperature water either to steam or low-temperature water. However, high-temperature water is more easily converted to low-temperature water for heating purposes.

It is the writer's opinion that there has been a tendency to unnecessarily over-complicate high-temperature water systems resulting in a too high initial cost and continuing high maintenance and operating costs. Be that as it may, the real saving in the high-temperature water system should be, and can be, in its maintenance and operation.

Maintenance and Operation

Little or no water treatment and make-up feed are necessary in the high-temperature water system. Within 24 hr after the high-temperature water system is in full operation, for all practical purposes, oxygen is eliminated from the system so there can be no corrosion, and therefore, a resultant extended useful life of the distribution lines. Furthermore, there is no scaling of the water sides of the boilers in a purely high-temperature water system. There are no traps throughout the distribution system with resultant maintenance. The convertor control can be rugged and require little or no more maintenance than the PRV - desuperheater complex.

Operating costs may be considered under two headings; i.e., (*a*) material, including fuel and (*b*) personnel. The flywheel effect of high-temperature water irons out large sudden fluctuations in the load, thus allowing a more uniform firing rate of the boilers. The high-temperature water returns to the boilers at an appreciably higher temperature than the condensate make-up feed mixture to the steam boilers. These two combine to contribute to the smaller size of the high-temperature water generators which in turn allows the generators to be fired at a rate close to their point of maximum efficiency. These add up to an appreciable saving in fuel.

The high-temperature water system can be, and should be, designed for rugged simple operation. The same personnel normally handling a steam plant should be fully qualified to operate the high-temperature water system. As stated before, it is the writer's opinion that many high-temperature water systems have been overdesigned. This results in complicated high cost control mechanisms which give an unnecessary degree of control and require too many and too highly trained operating personnel. It must be remembered that each additional person required to operate a system is actually four more men on the payroll. A simple rugged design might have a slightly less theoretical efficiency but even if this were conceded, the saving in the cost of personnel will more than offset it.

In summation, it is believed, speaking conservatively, that a properly designed high-temperature water system offers a reduction (a) in initial construction cost of 20 percent to 30 percent, (b) in fuel economy of about the same and (c) in maintenance up to at least 50 percent.

These remarks have been directed largely toward high-temperature water as a central heating plant. Even greater savings will be made when American industry is educated to the use of high-temperature water as a direct heating medium, as a heat source in manufacturing and as a by-product of process use.

There are now a good many high-temperature water systems in this country. It is high time for an Operations Research to be instituted to find cost factors objectively for such factors as original installation, fuel economy, operation and maintenance training, maintenance costs and occupational hazard. This requires investigation, accumulation of data, and careful interpretation.

SEMI-ANNUAL MEETING

Minneapolis, Minn.

Pick-Nicollet Hotel **June 23-25, 1958**

ASHAE Technical Advisory Committees

by Burgess H. Jennings*,
Cleveland, Ohio

FOR years Technical Advisory Committees of the Committee on Research have been of the greatest assistance to the Society. A Technical Advisory Committee comes into being whenever the Committee on Research feels that a group of people selected for breadth of experience and knowledge in a particular field could be of use in helping to plan for a research project, to prepare data and analyses, or perform similar functions for the benefit of the research program. Having decided that a committee is desirable, the Chairman of the Committee on Research makes appointments and decides on the initial organization of the committee. At present there are 18 active Technical Advisory Committees. The number changes up or down with changing needs. Frequently a committee completes the assignment for which it was created, and it is then discharged.

With the growth of the Society's research and technical programs, nomination to membership on a Technical Advisory Committee has been an honor, as well as a responsibility, as the appointment indicates a recognition of attainment and ability in a given field of endeavor. It naturally has followed that extremely competent individuals have been invited to serve again and again on the same Technical Advisory Committees. This was extremely desirable from the viewpoint of giving The Society the benefits of breadth of experience, but it was restrictive in another sense in that it did not permit widest usage by the Society of other members who also were willing to give of their time and ability to further the profession. Consequently, the Committee on Research last fall decided that a definite program of turnover might be desirable and in the best interest of the Society. Subsequently a set of regulations was formulated, and because it is desirable for the full Society membership to know of them, they are reproduced here in full.

(a) The membership of each Technical Advisory Committee shall be representative of all major interests of the Society in the work to be accomplished and shall, wherever possible, include representatives of the Society membership at large, of users, of professional and academic groups and of industry groups, provided that the membership of the committee shall not exceed 20, unless a greater number shall have been authorized in any given year by action of the Committee on Research.

(b) The chairman, vice chairman, and as many members of each committee as practicable shall be members of the Society.

(c) The chairman, or the vice chairman, shall be a member of the Committee on Research.

(d) Any member shall be eligible for reappointment until he has served three consecutive years. He shall not be eligible for reappointment after he has served for three consecutive years until a period of one year has elapsed, except by action of the Committee on Research which may each year authorize yearly reappointments for a further three years. Any member who has served for six consecutive years with the concurrence of the Committee on Research, shall not be eligible for further service until two years have elapsed.

(e) The acceptance of appointment to a Technical Advisory Committee implies a pledge of faithful attendance at meetings and meticulous attention to correspondence concerned with the functioning of the committee.

Because of the impact which would be felt by the Society if the regulations were completely put into effect at once, the Committee on Research was granted permission by the Council to use a 3-year period in which to implement fully the new regulations. This year when the Technical Advisory Committee members were selected by the chairman of the Committee on Research, the new regulations were implemented as completely as possible without destroying the effectiveness of any committee. Thus, there were a large number of changes in Technical Advisory Committee personnel.

Mention has been made of the formation of Technical Advisory Committees when the need of a committee is indicated. At present serious thought is being given to the formation of a Technical Advisory Committee on Control. Some thinking as to the scope of this committee might be gained by reference to a description of scope which was brought out at the last Committee on Research meeting.

To consider problems of control as applied to the air-conditioning industry in the broad sense of controllability, particularly as related to components and to system controllability characteristics and responses.

This field of control is so important that the Committee on Research is sponsoring an All-Industry Conference on Control and Controllability. Tentatively this will be held at the Research Laboratory in Cleveland on May 14, and a number of key panel speakers will develop leading questions relating to the controllability and the control function, following which, if the need is still indicated, a new Technical Advisory Committee will come into existence.

*Director of ASHAE Research.

Pulsations in Residential Gas Furnaces with Multiple-Port Burners

By A. A. Putnam*, Columbus, Ohio

This paper is the result of research sponsored jointly by the AMERICAN SOCIETY OF HEATING AND AIR-CONDITIONING ENGINEERS, the *American Gas Association* and the *Oil-Heat Institute of America, Inc.*, conducted through Battelle Memorial Institute.

SUMMARY — The manner in which oscillations in residential gas furnaces fired with multiple-port, ribbon, or slot burners are driven is postulated. It is indicated that the general operating conditions leading to oscillation are a function of (*a*) the product of the natural frequency of the burner and the time lag of the burner flame, and (*b*) the ratio of the furnace frequency to the natural frequency of the burner. The extent to which these operating conditions favor oscillation is a function of the ratio of the acoustic driving input from primary combustion to the acoustic damping losses. The time lag, which is the short time from the emergence from the burner of the combustible mixture to its burning in the primary flame, is a function of the burner-port configuration, the fuel, the mixture ratio, and the firing rate. To the accuracy with which these various factors could be determined, the theory has been confirmed from tests in 5 furnaces.

This is the third of a series of reports presenting results obtained from a research program directed toward the problems of combustion noise in oil- and gas-fired residential heating equipment. In an initial field work phase of this general research program, pulsations were observed in oil furnaces and in 2 basically different types of gas-fired furnaces, (1) those fired with single-port burners, and (2) those fired with multiple-port, slot, or ribbon burners. The oscillations associated with oil furnaces and single-port gas furnaces have been discussed in a preliminary way in previous papers[1,2].

Studies of horizontal gas furnaces equipped with multiple-port, slot, or ribbon burners show that this general class of furnace was of a higher frequency range than that encountered in furnaces equipped with single-port burners. An explanation for oscillations generated in such furnaces has been formulated in the present research program. This information is based on information obtained from the field studies and some supplemental laboratory tests on horizontal furnaces, plus the available information in the literature.

The purpose of this paper is to outline the postulated mechanism whereby oscillations may or may not exist in furnaces fired with multiple-port, slot, or ribbon burners; this will serve as a basis for a subsequent paper on engineering applications of the theory. The postulated mechanism by which the driving of the oscillation occurs is first described and then defined mathematically. A presentation and discussion of supporting experimental data concludes the paper. Basic features of furnaces that influence pulsation characteristics are considered in some detail in an Appendix†.

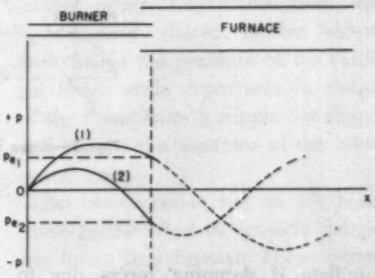

Fig. 1—Acoustical model for gas furnaces utilizing multiple-port burners

Mechanism of Driving

The mechanism for driving oscillations in a gas furnace using multiple-port burners, is arrived at by considering a certain type of organ-pipe acoustical model.

Fig. 1 illustrates this model. The burner heat-exchanger assembly is represented by 2 concentric open-ended tubes of different diameters. The smaller tube represents the burner which is shown entering within the larger tube representing a heat-exchanger section.

If a standing wave exists in the assembly, the portion of the standing wave in the burner will, in general, take either a form similar to Curve (1) which has a zero pressure (ambient pressure) node at some point beyond the end of the burner tube, or a form similar to Curve (2) which has a node within the burner tube. As a consequence, the pressure at the end of the burner tube will fluctuate, taking on values such as p_{e1} or p_{e2} shown in Fig. 1 merely to illustrate 2 values of a time variable.

If there is a flow into the furnace at the end of the burner tube, the flow will not remain constant as there will be added a velocity fluctuation due to the fluctuation in pressure. Theoretically, the fluctuation in velocity is ¼ wavelength out of phase with the pressure fluctuation.

Fig. 2 illustrates the case where the velocity wave leads the pressure wave by 1/4 cycle. The figure would

*Assistant Division Chief, Battelle Memorial Institute.

[1]Exponent numerals refer to References.

For presentation at the Semi-Annual Meeting of the AMERICAN SOCIETY OF HEATING AND AIR-CONDITIONING ENGINEERS, Minneapolis, Minn., June 1958.

†It is planned to publish the Appendix to this paper in the TRANSACTIONS 1958.

not change if the lead was 5/4 cycle, 9/4 cycle, and so on. Fig. 3 illustrates the case where the velocity wave lags the pressure wave by 1/4, 5/4, (and so on) cycle.

A change in the velocity of the gases means a change in the quantity of mixture available for burning and a similar change in the rate of heat release. By Rayleigh's principle, a component of fluctuating heat addition must take place in phase with the pressure wave if the oscillation is to be driven. Obviously, if burning took place exactly at the mouth of the burner and if the flame were infinitely thin, the heat addition wave would coincide with the velocity wave and not with the pressure wave and the oscillation would not be driven.

However, in an actual furnace, the flame does not attach itself flatly in the burner mouth, but at some distance away from the burner where the burning occurs over a finite distance. Because it takes time to travel this distance, there is thus introduced a *time lag* between the velocity wave and the heat addition wave which may bring the latter to coincide in time with the pressure wave as shown by the dashed curves in Figs. 2 and 3. If this occurs, oscillations will be driven; if the time-lag is sufficiently different from that needed to match the pressure wave, oscillations will not occur. Detailed discussion of the factors affecting time lag, as well as those affecting the aforementioned standing-wave shapes, is presented in the Appendix.

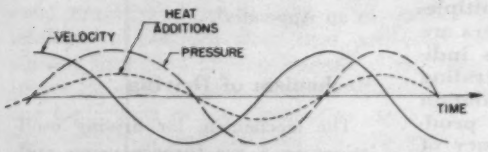

Fig. 2—Case where the velocity wave leads the pressure wave by 1/4, 5/4, . . ., cycles

Even if the mentioned time-lag condition necessary to promote oscillations is met, the furnace may not oscillate if damping forces due to openings to the outside of the furnace, to bends, to friction, and like causes, exceed the force driving the oscillations. It is not surprising, therefore, that oscillations occur in only a small percentage of installations. However, even a small percentage can be extremely troublesome.

This description of events in the system will now be enlarged as a basis for developing a mathematical model of driving of oscillations. To simplify the mathematics, a sine-wave shape is assumed for the pressure and velocity waves. Past experience has indicated that this assumption, even if not true, does not affect the broad conclusions of this study. On this basis, the oscillating pressure, p, and velocity, v, along the burner from the upstream end are given by[3]

$$p = p_o \sin(\omega x/c) \sin \omega t,$$
$$v = (p_o/\rho c) \cos(\omega x/c) \cos \omega t.$$

At the natural angular frequency of the burner, ω_b, the pressure at the downstream end is zero. Thus

$$\omega_b L = \pi c,$$

where

L = the equivalent burner length.

When furnace oscillations occur, the burner does not oscillate with its natural frequency but with the observed frequency of the furnace. If this observed frequency is slightly higher than the natural burner frequency, then the pressure at the furnace end of the burner will vary with the pressure in the furnace, while a short distance inside the burner, the pressure amplitude will be zero. This follows from the fact that zero pressure amplitude still exists at the inlet end of the burner, and the wavelength of oscillation is less than the natural wavelength of the burner. Thus, on the basis of the

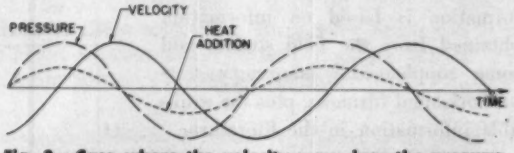

Fig. 3—Case where the velocity wave lags the pressure wave by 1/4, 5/4, . . ., cycles

Nomenclature

a = effective radius of port or half width of slot.
c = velocity of sound.
F = burning velocity.
b = oscillating component of the rate of heat release; flame height.
L = equivalent burner length, $c/2\nu_b$.
p = oscillating component of the pressure.
p_o = index pressure.
p_o = oscillating pressure in furnace at burner port level.
R_e = Reynolds number.
t = time.
v = oscillating component of the velocity.
v_o = oscillating component of the velocity at burner port.
V_p = average velocity through ports.
x = coordinate.
q = constant to be evaluated from tests.
δ = dark space (distance between the top face of the burner and the bottom of the flame).
ν = frequency.
ν_b = natural frequency of burner.
ρ = density.
τ = time lag.
ω = angular frequency, $2\pi\nu$.
ω_b = angular natural frequency of burner, $2\pi\nu_b$.

simple organ-pipe-tube analogy, a half wavelength does not reach entirely through the burner. Since air tends to rush toward the points of zero pressure amplitude from the region where pressure is decreasing, it follows that there must be an oscillating component of velocity through the burner exit. When the observed frequency is a little above a natural burner frequency, the oscillating component of the velocity at the ports leads the oscillating component of the pressure, while the opposite is true when the observed frequency is a little lower than the natural frequency. In mathematical form, the pressure at the burner exit, p_e and the exit velocity v_e, are given by

$$p_e = p_b \sin\left(\frac{\omega}{\omega_b}\right)\pi \sin\omega t = p_b \sin\left(\frac{\nu}{\nu_b}\right)\pi \sin\omega t,$$

$$v_e = \left(\frac{p_b}{\rho c}\right)\cos\left(\frac{\omega}{\omega_b}\right)\pi \cos\omega t = \left(\frac{p_b}{\rho c}\right)\cos\left(\frac{\nu}{\nu_b}\right)\pi \cos\omega t$$

As stated earlier, there must not be only pulses in the rate of flow of combustible gases, but these gases must burn at the right time in relation to the pressure variation in the furnace. If the oscillating component of the gas exiting from the ports leads the pressure variations in the furnace by ¼ cycle, then the best value for the time lag to produce oscillations would be about ¼ cycle. Except for the presence of complications to be mentioned later, a time lag of 1-¼ cycle, 2-¼ cycle, and so on, would seem equally desirable. On the other hand, if the velocity were lagging the pressure in the furnace by ¼ cycle, then the optimum values would be about ¾, 1-¾, and so forth. Thus, the changeover points would occur at integer values of $2\tau/(1/\nu)$, or $2\ \tau\ \nu$, where τ is the *time lag*.

Expressing this idea more formally, driving of the oscillation will occur when an oscillating component of the heat release from the burner is in phase with the pressure in the furnace, or neglecting damping forces

$$\int_{cycle} hp\,dt > 0$$

Since the pressure in the furnace at the burner is p_e, and the rate of heat release lags the injection of the mixture from the ports by the time lag, τ, so that

$$h_t \sim v_e\ (t - \tau)$$

the inequality becomes

$$\int_{cycle}\left[\left(\frac{p_b}{\rho c}\right)\cos\left(\frac{\nu}{\nu_b}\right)\pi \cos\omega(t-\tau)\right]\left[p_b \sin\left(\frac{\nu}{\nu_b}\right)\pi \sin\omega t\right] dt$$
$$= \left(\frac{p_b^2 \pi}{2\rho c \omega}\right)\sin\omega\tau \sin 2\pi\left(\frac{\nu}{\nu_b}\right) > 0$$

Since $(p_b^2\ \pi/2\ \rho\ c\ \omega)$ is always positive, driving may occur whenever

$$\sin\omega\tau \sin 2\pi\left(\frac{\nu}{\nu_b}\right) = \sin 2\pi\nu\tau \sin 2\pi\left(\frac{\nu}{\nu_b}\right) > 0 \cdots\cdots(1a)$$

or

$$\sin 2\pi\left(\frac{\nu}{\nu_b}\right)\left(\frac{1}{2}\tau\right)\sin 2\pi\left(\frac{\nu}{\nu_b}\right) > 0 \cdots\cdots(1b)$$

Fig. 4a is a map of the oscillating regions of a simple burner, as deduced from the inequality, Equation 1a. The regions in which oscillations can occur are crosshatched. Where there is no crosshatching oscillations cannot occur. Departures from the hypothesized simple burner shape will change the positions of the vertical lines, while departures in shape of the flame from a simple flat shape will change the positions of the horizontal lines.

No consideration has as yet been given to the effect of acoustic damping forces in a furnace. These forces are ever present in wall losses, losses from sudden expansions and contractions, and end losses or acoustic radiation to the surroundings. A complete consideration of these losses is beyond the scope of this paper, and could not in any case be related to a particular furnace design with the present status of knowledge. However, it is clear that such losses will decrease the range of variables in which oscillations are possible in a furnace. Mathematically, such damping forces are provided for by replacing the zero of the inequality of Equations 1a and 1b by a positive

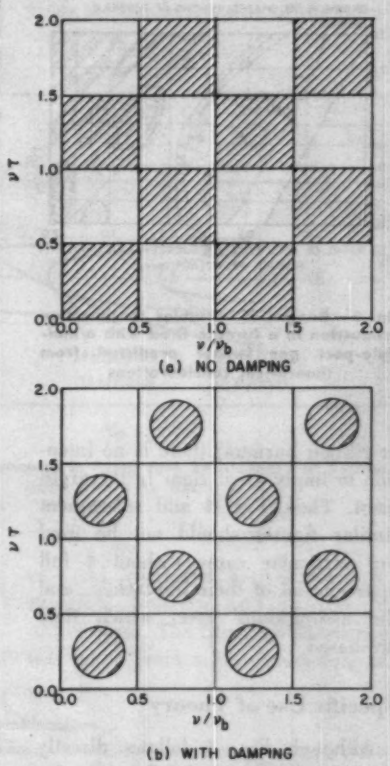

Fig. 4—Regions of pulsation in simple multiple-port burner

term, the value of which depends upon (*a*) the manner in which the damping forces are produced and (*b*) the observed frequency of the furnace.

Fig. 4b shows the effect of such damping losses on the results of Fig. 4a. As the losses increase, or the driving forces decrease, these crosshatched areas would decrease until they vanish. It might be mentioned that the fact that the flame is not flat causes the areas to decrease in size also, as $\nu\tau$ increases.

This general description of the theory has been presented to give an overall grasp of the problem of predicting the ranges of variables for which oscillation can occur in furnaces fired with multiple-port, slot,

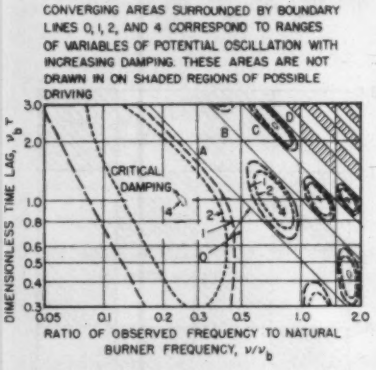
CONVERGING AREAS SURROUNDED BY BOUNDARY LINES 0, 1, 2, AND 4 CORRESPOND TO RANGES OF VARIABLES OF POTENTIAL OSCILLATION WITH INCREASING DAMPING. THESE AREAS ARE NOT DRAWN IN ON SHADED REGIONS OF POSSIBLE DRIVING
DIMENSIONLESS TIME LAG, $\nu_b \tau$
CRITICAL DAMPING
A
B
C
D
RATIO OF OBSERVED FREQUENCY TO NATURAL BURNER FREQUENCY, ν/ν_b

Fig. 5—Ranges of variables for pulsation production in a furnace fired with a multiple-port gas burner predicted from theoretical considerations

or ribbon burners; there is no intention to imply great rigor in the argument. Thus, Fig. 4 and subsequent similar figures should not be used for particular cases without a full appreciation of their limitations, and the assumptions upon which they are based.

Specific Use of Theory

Although Fig. 4 follows directly from the application of Equation 1a, and is readily understood, the pair of dimensionless groups involved in the coordinates, $\nu\,\tau$ and ν/ν_b, are not the most convenient for comparison with experimental data. On the other hand, an alternate dimensionless group, $\nu_b\,\tau$, combines only parameters related to the burner. From Equation 1b it can be seen that this group can be used equally well with ν/ν_b to define the oscillating and nonoscillating regions. However, for the new terms a log-log plot now makes a more convenient coordinate system.

Fig. 5 is such a figure, corresponding to Fig. 4b, and showing a development from Equation 1b of the type of log-log plot just mentioned. The ranges of variables in which driving of an oscillation is potentially possible are delineated by the diagonal lines, A, B, C, D, . . . and the vertical lines at 0.5, 1.0, 1.5, . . . and may be identified by the patterns of included boundary lines in the lower left portion of the figure, and by the crosshatched areas in the upper right-hand portion. It is seen that the ranges of variables of potential driving alternate in a checkerboard pattern with ranges for which the oscillations will not occur. For an actual burner, as contrasted to the idealized shape used in the foregoing mathematical derivation, the positions of the vertical and diagonal lines and corresponding ranges of variables would be shifted, but the alternating characteristic of the patterns would not change. With damping present, the ranges of variables for which driving will occur are smaller; the regions enclosed by the boundary lines labeled 1, 2, and 4 on Fig. 5 are an example of the effect of increasing the damping. Likewise, if the damping effects are constant, the ranges of variables for which the driving will occur decrease in size in the order 1, 2, 4 as the input of driving energy decreases. The numerical designations of the boundary lines surrounding driving regions in Fig. 5 are such that, for constant damping, the product of these numerical designations by the driving output remains constant for a given system. For example, consider a furnace in which the ratio of driving to damping forces is such that oscillations occur when $\nu_b\tau$ and ν/ν_b are such that the operating point is within boundary line 2 enclosing the point (0.25, 1.0). Now if the heat-release rate of the primary flame is doubled, the region in which oscillations are possible will expand to that enclosed by boundary line 1.

As one passes successively upward or to the right across the 45 deg diagonals designated by A, B, C . . ., the effect of the deviation of the flame from a flat shape becomes increasingly important. For constant time lag, this deviation is related to the port Reynolds number. Thus, for increasing values of port Reynolds number, of $\nu_b\tau$, or ν/ν_b, a lesser portion of the oscillating heat input is devoted to driving; this may be considered the equivalent of an increase in boundary-line number.

The amplitude of oscillation is expected to be related somewhat to the difference in the operating values of the parameters and the values at the corresponding boundary line. However, the non-linear character of the oscillating mechanism precludes any exact prediction of amplitude.

Experimental Results

Fig. 6 shows all the gas furnace frequencies observed during the field tests conducted in the initial phase

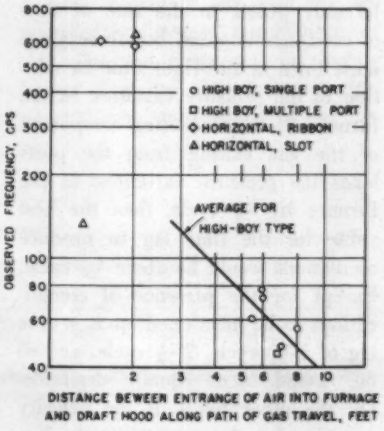
OBSERVED FREQUENCY, CPS
HIGH BOY, SINGLE PORT
HIGH BOY, MULTIPLE PORT
HORIZONTAL, RIBBON
HORIZONTAL, SLOT
AVERAGE FOR HIGH-BOY TYPE
DISTANCE BETWEEN ENTRANCE OF AIR INTO FURNACE AND DRAFT HOOD ALONG PATH OF GAS TRAVEL, FEET

Fig. 6—Frequency of oscillation as a function of furnace size

of this research. The observed frequencies for 3 of the 4 horizontal furnaces were about 600 cps. The frequency for the fourth unit was only 135 cps, although from the length of flue-gas travel, it was expected to have the highest frequency.

One of the high-boy units had a multiple-port burner, but its frequency was found to be in line with those of the other high-boy units fired with single-port burners. However, the mechanism of driving in the high-boy unit equipped with the multiple-port burner is the same as for the horizontal units, as a consequence of the similarity in burners. Two of the horizontal furnaces tested, the propane-fired unit with the 620 cps frequency, and the natural gas-fired unit with the low frequency of 135 cps, were studied more extensively at a later date; additional tests also were run on the burners separate from the furnaces from all 4 horizontal units and on the multiple-port high-boy burners.

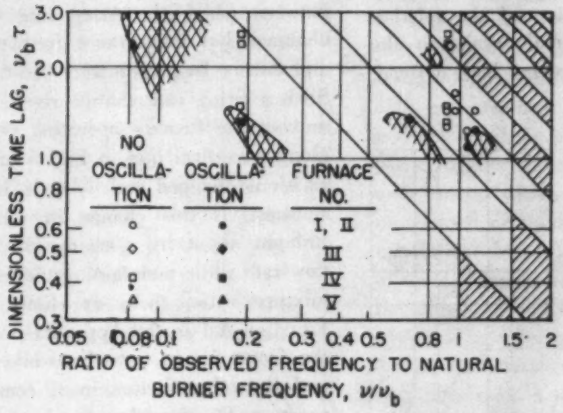

Fig. 7—Comparison of experimental results with theoretical results

Table 1 is a compilation of the pertinent data obtained in all tests. Six different burners and 5 different furnaces were studied, but extensive tests were made only on furnaces I and IV. Burner frequencies were measured when they were in open space and then corrected for an assumed air-fuel ratio composition in the burner of 65 percent of stoichiometric. The firing rate was taken from the nominal rating of the burner, and corrected for changes in manifold pressure and in size of orifice spud. The observed frequency was taken from a tape recording of

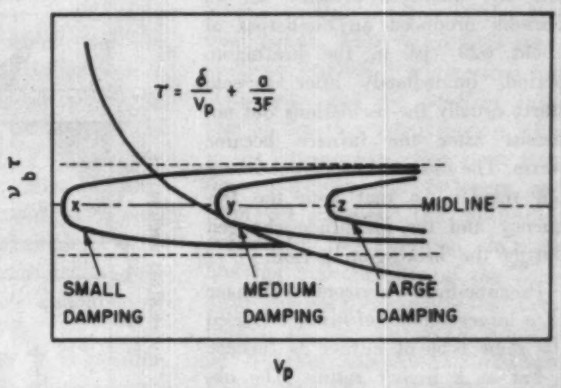

Fig. 8—Effect of change in firing rate on presence of oscillations with ν/ν_b fixed

Table 1 — Results of tests on various burner-furnace combinations

	Burner										Furnace				
Burner Type	Normal Fuel	Meas Freq	Test Fuel	Corr[b] Freq	Firing Rate, Btu/hr	Port Loading Btu/hr, in.^{2}	$10^3(\delta/V_P)$	$10^3(a/nF)$	$10^3\tau$	$\nu_b\tau$	Furnace No.	Obs Freq	Freq Ratio	Oscillation	Symbol on Fig. 7
A-Ribbon	Propane	650	Propane	635	22,000	8,400	1.88	0.70	2.58	1.64	I	620[e]	0.976	No	○
					27,000	10,300	1.53	0.70	2.23	1.42	I	620[e]	0.976	No	○
					27,000	10,300	1.53	0.70	2.23	1.42	II	580[e]	0.913	No	○
					33,000	12,500	1.26	0.70	1.96	1.24	II	580[e]	0.913	No	○
B-Ribbon	Propane	560	Propane	546	22,000	8,400	1.88	0.70	2.58	1.41	I	620[e]	1.136	No	○
					27,000	10,300	1.53	0.70	2.23	1.22	I	620	1.136	Yes	●
					27,000	10,300	1.53	0.70	2.23	1.22	II	580[e]	1.062	No	○
					33,000	12,500	1.26	0.70	1.96	1.07	II	580	1.062	Yes	●
C-Milled Slot	Nat gas	637	Mfg gas	1010	45,000	19,500	0.405	0.90	1.3	1.31	III	650	0.694	Yes	◆
			Nat gas	654	45,000	19,500	0.585	2.92	3.5	2.29	III	600[d]	0.923	No	[g]
D_1-Milled Slot	Mfg gas	694[a]	Nat gas	713	42,000	31,000	0.364	1.61	2.07	1.48	IV	135	0.189	No	□
					68,000	50,000	0.223	1.61	1.83	1.30	IV	135	0.189	Yes	■
					42,000	31,000	0.364	1.61	2.07	1.48	IV	650[e]	0.91	No	□
					68,000	50,000	0.223	1.61	1.83	1.30	IV	650[e]	0.91	No[f]	□
D_2-Milled Slot	Nat gas	694	Nat gas	713	42,000	19,000	0.602	2.92	3.52	2.50	IV	135	0.189	No	□
					68,000	30,200	0.371	2.92	3.29	2.35	IV	135	0.189	No	□
					42,000	19,000	0.602	2.92	3.52	2.50	IV	650[e]	0.91	No	□
					68,000	30,600	0.371	2.92	3.29	2.35	IV	650[e]	0.91	No	□
E-Drilled Port	Nat gas	520 505 528	Nat gas	532 avg.	105,000	26,000	0.436	4.03	4.47	2.38	V	45	0.084	Yes	▲

[a]Value assumed same as for natural gas burner.
[b]Assuming 65 percent of stoichiometric.
[c]Value obtained from corresponding furnace where oscillation occurred.
[d]Extremely weak and transient note.
[e]Value obtained from Furnace III with same length of heat exchanger tubes.
[f]It should be considered that this oscillation might have occurred at 135 cycles.
[g]Indicates open diamond on Fig. 7.

the furnace if oscillation occurred. When no oscillation occurred, the furnace frequency was assumed to be the same as under oscillatory conditions. The fuel parameters used in computing the time lag were obtained from Table A-1 in the Appendix.

Propane-fired horizontal furnace I would not generate oscillations with burner A. With burner B, overfiring by increasing the orifice spud size and the manifold pressure on all burners produced an oscillation of about 620 cps in the heating-up period, immediately after a cold start; usually the oscillations did not persist after the furnace became warm. The observed oscillations were not regular, in that both the frequency and the amplitude changed during the heating-up period.

Propane-fired horizontal furnace II, a larger version of furnace I, used the same type of burner as furnace I but at a higher rating. The observed frequency, using burner B, and when overfiring, was somewhat less than that of furnace I. No oscillation was obtained in furnace II with burner A even when overfiring.

Furnace III was a moderate-sized horizontal furnace equipped with milled slot natural-gas burners. By using manufactured gas, this furnace could be made to oscillate intensely. Using natural gas, however, only a weak and transient oscillation that was barely detectable could be produced.

Furnace IV was somewhat smaller than furnace III, but had the same length of heat exchanger section. However, it had an observed frequency of about 135 cps when fired with natural gas through manufactured gas burners; the frequency was much lower than those for other horizontal furnaces. As is discussed in more detail in the Appendix, this resulted from the furnace acting as a double-necked Helmholtz resonator.

Furnace V was a home installation of an older design of high-boy equipped with 3 drilled-port burners which, in combination, formed a circular grid.

Correlation of Experimental Results with Theory

In the discussion of the relation of the experimental results to the general theory that has been derived,

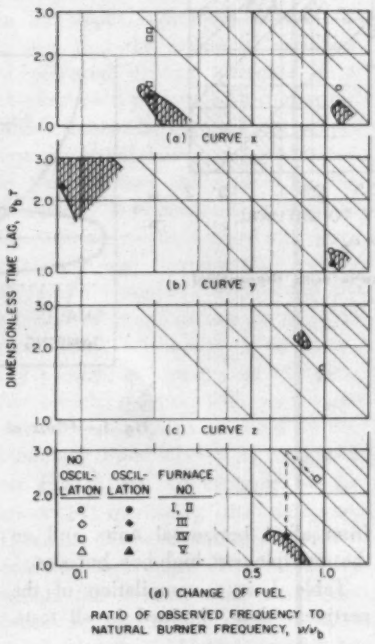

Fig. 9—Sub-plots of figure 7

sets of data will be considered as they pertain to the clarification of certain specific points. Thus, the order of presentation used in Table 1 will not necessarily be followed herein.

Fig. 7 is a replot of pertinent portions of Fig. 5, with selected data points from Table 1 superimposed. Positions of the boundary lines indicating the apparent relation of driving to damping forces for each set of data are sketched in, rather than the sets of boundary lines in Fig. 5. In regions where theory indicated no oscillations should occur, none was found. In regions where theory indicated oscillations were possible, several instances were observed in which they occurred. These later data will be discussed next.

Fig. 8 affords a useful basis for considering each pair of data points between which the firing rate was changed, but the furnace frequency and burner frequency were constant. Such a firing rate change results in moving the furnace operating point along a vertical line in Fig. 5 or 7, as $\nu_b\tau$ is changed and ν/ν_b is held constant. If this change in $\nu_b\tau$ is brought about by a change in the flow rate while maintaining the same mixture ratio, then, as shown in Equation A-1 in the Appendix†, only the factor V_p in τ varies while ν_b, and the other factors in τ, remain constant. On the other hand, as the mixture flow rate increases, the energy release for driving the oscillation increases and thus the range of variables within which oscillations occur increases. Thus, one may sketch a series of curves such as shown in Fig. 8 for 3 degrees of acoustic damping. Considering as an example a value of $\nu/\nu_b \cong 0.6$ on Fig. 5, the dashed lines of Fig. 8 would correspond to lines A and B of Fig. 5 where they intersect $\nu/\nu_b = 0.6$, and Curves x, y, and z of Fig. 8 would correspond in a sense to boundary lines 1, 2, and 4 of Fig. 5.

Fig. 9 presents several sub-plots of Fig. 7, for purposes of comparison with the curves of Fig. 8. For instance, Fig. 9a presents the data which correspond to the case associated with Curve x of Fig. 8. For Curve x, wherein the relative damping is low, oscillation will occur over a wide range of $\nu_b\tau$, practically the entire possible range of oscillation; this case is illustrated in the sense of increasing V_p, by the change on Fig. 9a along $\nu/\nu_b = 1.136$ from $\nu_b\tau = 1.41$ to 1.22. Another example of the Curve x condition is shown by the series of points along $\nu/\nu_b =$

†Equation A1 is: $\gamma = \sigma/V_p + \alpha/\pi\tau$.

0.189, leading to a Helmholtz-type oscillation in furnace IV.

In the case of Curve y of Fig. 8, the relative damping is larger, and only a small region of oscillation is indicated. This region, it may be noted, is entirely below the midline in the potential oscillating range. It is believed that such a condition is involved in the case of the passing along the line on Fig. 9b represented by $\nu/\nu_b = 1.062$ from $\nu_b\tau = 1.22$ to the oscillation point. The datum point on Fig. 9b from furnace V, at $\nu/\nu_b = 0.0184$, is also believed to correspond to case y.

In the case of Curve z of Fig. 8, the damping forces are large enough that no oscillation occurs. This probably is illustrated by the datum point for furnace I on Fig. 9c.

The data points of Fig. 9d, obtained from furnace III, conform to the expected patterns of results, but are also interesting because they show the effect of change of fuel. The first effect of change of fuel is to change the natural frequency of oscillation of the burner. If the fuel is changed to one of less density, such as changing from methane to manufactured gas, the frequency of the burner increases. With no change in time lag, this would move the operating point along a 45 deg slope on Fig. 9d, upward to the left. For the same heat-release rate, the volume flow rate does not change much. However, when the burning velocity of the fuel increases, as in changing from methane to manufactured gas, the dark space can be expected to decrease. Both of these factors cause a decrease in the value of τ. Thus, the operating point moves downward. The net result in changing from methane to manufactured gas is shown by the positions of the two diamonds on Fig. 9d.

Concluding Remarks

A logical basic mechanism of combustion-driven oscillations in furnaces equipped with multiple-port, slot, or ribbon burners has been described. This mechanism is based on a considerable amount of observation reported in the literature. Test results obtained in this program are also in agreement with the theory, and this tends to support this application of the theory. However, several factors which are incompletely understood or upon which there are insufficient data affect the occurrence of oscillations. One factor involved is the time lag, and the manner in which it is affected by burner-port design, fuel, mixture ratio, and mixture flow rate. A second factor concerns the relative magnitude of driving and damping terms involved in determining the stable amplitude of oscillations.

By laboratory tests it is possible to define the region in which a given furnace design is operating, even without a knowledge of all the foregoing factors. This can be done by making discrete changes in the burner and furnace, and estimating unknown values as closely as possible. This information can be used as a basis for judgment in determining how close a design is to unstable operating conditions, and what design factors may be changed to improve the situation. Some suggested areas for design changes and the principal factors they alter are: (1) porting design — τ, (2) effective burner length — ν_b, (3) length of heat exchanger section — ν, (4) baffling in heat exchangers and flueways — ν, (5) inlet baffling — ν for Helmholtz frequency, and (6) relative position of burner head and heat exchanger inlet — ratio of driving to damping forces. Which of these changes might be preferred depends on the relative position of the operating region of the design and the oscillating regions of Fig. 5, and the susceptability of the design to economical alteration of various features.

Acknowledgments

It is desired to acknowledge the assistance of W. R. Dennis, Gail M. Clough, and Carl F. Speich in obtaining various portions of the data used herein. This research is sponsored by ASHAE, the *American Gas Association* and the *Oil-Heat Institute of America, Inc.*; support within the latter organization came from the equipment manufacturers and from oil refiners. The project is guided by the Pulsation Research Steering Subcommittee of the Technical Advisory Committee on Combustion of the AMERICAN SOCIETY OF HEATING AND AIR-CONDITIONING ENGINEERS. The able assistance of the members of that Subcommittee not only in guiding the work but in providing necessary information and materials is gratefully acknowledged. Special thanks are due to the personnel of the Armstrong Furnace Co. and the Surface Combustion Corp., both of Columbus, Ohio, who provided the experimental furnaces used.

References

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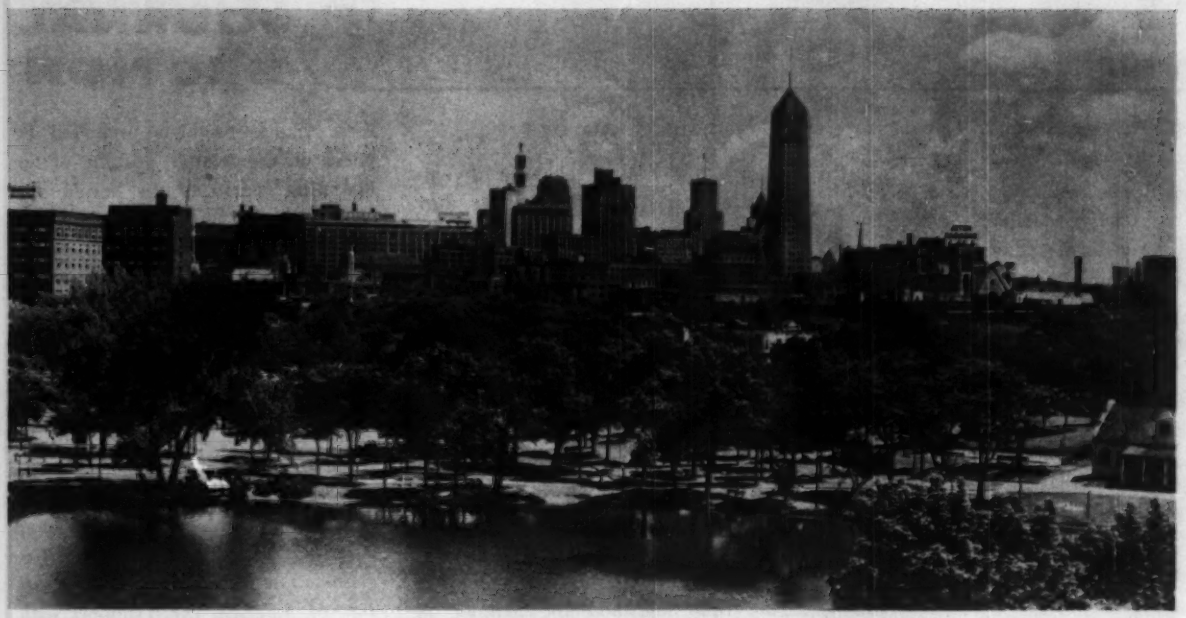
2. RESEARCH REPORT No. 1612 — Acoustic Coupling of Residential Furnaces with Their Surroundings, by C. F. Speich, W. R. Dennis and A. A. Putnam (ASHAE TRANSACTIONS, Vol. 63, 1957, p. 413).

3. *Vibration and Sound*, by Philip Morse (McGraw-Hill Book Co., Inc., New York, 1948.



Skyline of Minneapolis as seen from Loring Lake

City of Lakes, Parks, Boulevards Site for June Semi-Annual Meeting

Society Meetings provide members with the opportunity of visiting many well-known American cities. This June 23-25 the Semi-Annual Meeting city is no exception.

The Minnesota Chapter Committee on Arrangements, J. S. Locke, general chairman, hopes to encourage members to bring their families and *linger longer in the land of 10,000 lakes.*

As a suggestion they point out that helpful information about Minnesota resorts can be obtained by writing the *Minnesota Resort Association* in Minneapolis.

This is in addition to the ASHAE Semi-Annual Meeting in the Pick-Nicollet Hotel and the *ASRE* 54th Annual Meeting in the Leamington.

Local members of both Societies are working together on special events such as the *County Fair* planned for Monday night. It has been hinted by the local committee that members should bring along some *county fair clothes and plan to ride the rails.*

The ladies and children are not being overlooked. They will be entertained while the members are attending the technical sessions.

Those unfamiliar with Minneapolis will find that its 152 landscaped parks covering nearly 6000 acres have a breathtaking natural beauty. The Mississippi flows through the city over historic St. Anthony Falls, and within the city limits there are numerous lakes providing facilities for bathing and fishing.

Culturally, Minneapolis has much to offer the sightseeing visitor. The University of Minnesota is among the leading educational institutions in the country, and The Mayo Foundation for Graduate Medical Study and Research is located at the University Medical School. The Northrop Memorial Auditorium, also on the University campus, is the home of the world renowned Minneapolis Symphony Orchestra.

Other interesting places are the Walker Art Center, Minneapolis Institute of Art, the Swedish-American Museum and the University of Minnesota Gallery.

The ASHAE Semi-Annual Meeting, the *ASRE* 54th Annual Meeting, many special events, and the different things to do and see in Minnesota are favorable arguments why you and your family should come to Minnesota next June.

Nicollet Avenue where a majority of retail stores are located

Tentative Technical Program

Semi-Annual Meeting

Pick-Nicollet Hotel **Minneapolis, Minn.** **June 23-25, 1958**

Monday — June 23

9:00 a.m. FIRST SESSION

Call to Order — Pres. E. R. Queer

A Water Cooled Luminaire in a Panel Air System, by W. F. Spiegel

Pulsations in Residential Gas Furnaces with Multiple-Port Burners, by A. A. Putnam

Evaluation of Air Cleaners for Air Conditioning and Ventilation, Part I — Apparatus, by K. T. Whitby, A. B. Algren, R. C. Jordan and J. C. Annis

Tuesday — June 24

9:00 a.m. SECOND SESSION

Call to Order — 1st Vice Pres. A. J. Hess

Winter Infiltration Through Swinging-Door Entrances in Multi-Story Buildings, by T. C. Min

Corrosion Inhibition on Tubes in Low-Pressure Steel Boilers, by W. A. Keilbaugh and F. J. Pocock

Heat Gain Thru Windows Shaded by Canvas Awnings, by Necati Ozisik and L. F. Schutrum

9:30 a.m. THIRD SESSION

Call to Order — 2nd Vice Pres. Walter A. Grant

SYMPOSIUM ON THERMAL INSULATION

P. N. Vinther, *Symposium Manager*

M. W. Keyes, *Moderator*

Reflective and Bulk Insulation, by William Turberville

Block and Pipe Insulation, by R. B. Crepps

Vapor Problems in Thermal Insulation, by N. B. Hutcheon

Thermal Insulation for Nuclear Systems, by G. W. Pomeroy

Surfacings for Glass Fiber and Foam Thermal Insulation, by W. P. Ellis

Wednesday — June 25

9:30 a.m. FOURTH SESSION

Call to Order — Treas. J. H. Fox

SYMPOSIUM ON CONDENSING METHODS

W. G. Hole, *Symposium Manager*

A. J. Hess, *Moderator*

Cooling Tower Design and Performance, by John Engalitcheff

Evaporative Condensers, by D. D. Wile

Air Cooled Condensers, by Otto Nussbaum

Economic Evaluation of Condensing Methods, by J. L. Wolf

9:30 a.m. FIFTH SESSION

Call to Order — Pres. E. R. Queer

Activated Charcoal for Air Purification, by H. L. Barnebey

Cooling Load from Pretabulated Impedances, by Harry Buchberg

Solar Energy Utilization for Heating, Cooling, Distillation and Drying — prepared by TAC on Solar Energy Utilization

Report of Resolutions Committee

Unfinished Business; New Business; Adjournment

TYPICAL TRANSPORTATION RATES* TO MINNEAPOLIS FROM CHAPTER CITIES

City	Round Trip By Air	1st Class Round Trip By Rail	One Way Roomette	One Way Seat†
Albany, N.Y.	$139.00	$ 94.40	$ 8.10	2.40
Albuquerque, N.M.	144.30	91.35	26.50	
Atlanta, Ga.	130.54	79.65	17.10	
Austin, Tex.	152.97	94.65	17.10	2.40
Baltimore, Md.	114.20	100.60	13.25	2.40
Baton Rouge, La.	154.10	93.20	16.00	2.40
Boston, Mass.	156.20	139.76	16.00	2.40
Buffalo, N.Y.	93.80	85.10	9.40	2.40
Charlotte, N.C.	134.73	94.40	17.00	
Chicago, Ill.	47.42	28.30		2.40
Cincinnati, Ohio	84.66	61.45	8.10	2.40
Cleveland, Ohio	77.20	66.30	8.10	2.40
Columbia, S.C.	94.81	95.95	18.10	
Columbus, Ohio	75.71	63.55	8.10	2.40
Dallas, Tex.	119.60	68.15	18.65	
Dayton, Ohio	78.39	58.45	8.10	2.40
Denver, Colo.	110.39	61.85	16.00	
Des Moines, Iowa	33.72	18.55	8.10	
Detroit, Mich.	66.70	55.65	10.50	
Edmonton, Canada	135.30	82.00	19.70	
El Paso, Tex.	207.59	101.10	24.75	
Grand Rapids, Mich.	48.73	49.32	8.10	2.40
Greensboro, N.C.	146.30	97.95	21.25	
Hartford, Conn.	141.19	128.62	14.40	2.40
Houston, Tex.	138.70	85.45	22.20	
Indianapolis, Ind.	71.55	49.32	8.10	2.40
Jackson, Miss.	139.00	80.85	9.40	2.40
Jacksonville, Fla.	165.03	103.55	23.25	
Johnstown, Pa.	101.90	58.95	11.30	
Kansas City, Mo.	55.95	33.75	9.40	
Little Rock, Ark.	132.07	75.30	10.55	2.40
Los Angeles, Cal.	228.57	136.05	33.80	
Louisville, Ky.	85.23	62.35	8.10	2.40
Lubbock, Tex.	140.03	80.75	24.90	
Memphis, Tenn.	116.11	66.20	9.40	2.40
Milwaukee, Wis.	36.50	23.25	8.10	1.95
Montreal, Canada	146.50	100.45	16.80	
Newark, N.J.	123.70	126.25	14.40	2.40
New Orleans, La.	160.00	93.65	16.00	2.40
New York, N.Y.	123.70	126.25	14.40	2.40
Norfolk, Va.	131.30	82.30	16.00	2.40
Oklahoma City, Ok.	98.51	57.60	....	
Omaha, Neb.	40.47	24.50	....	
Ottawa, Canada	135.50	79.95	14.15	
Philadelphia, Pa.	116.70	80.25	13.25	2.40
Phoenix, Ariz.	170.14	131.55	31.55	
Portland, Ore.	194.14	106.35	29.15	
Pittsburgh, Pa.	92.40	79.35	8.10	2.40
Sacramento, Cal.	249.38	136.05	33.80	
St. Louis, Mo.	67.83	40.60	6.70	
Salt Lake City, Utah	131.36	93.65	23.25	
San Antonio, Tex.	147.53	107.30	26.50	
San Francisco, Cal.	249.37	136.05	33.80	
Savannah, Ga.	154.77	101.10	22.20	
Seattle, Wash.	194.14	106.35	29.15	
Shreveport, La.	154.58	68.10	19.25	
Spokane, Wash.	162.56	87.80	24.75	
Springfield, Mass.	146.89	128.62	14.40	2.40
Syracuse, N.Y.	124.56	101.10	10.55	2.40
Toledo, Ohio	66.70	54.98	8.10	2.40
Toronto, Canada	101.50	62.75	11.80	
Tulsa, Okla.	83.60	50.90	9.40	
Vancouver, Canada	181.30	106.35	29.15	
Washington, D. C.	114.20	110.90	13.25	2.40
Wichita, Kan.	80.08	48.55	9.50	
Winnipeg, Canada	54.30	30.80	8.10	

*Above rates subject to 10% tax (except from Canada). Rates subject to change without notice.

†Seat, one way Chicago to Minneapolis

State Board Problems — Financing and Others

By

Clayton B. Hershey

The author is an Engineer with the Division of Architectural Services, Bureau of School Buildings, Department of Public Instruction, Harrisburg, Pa. A presentation at the Symposium on School Heating, Ventilating and Air Conditioning at the 64th Annual Meeting of the AMERICAN SOCIETY OF HEATING AND AIR-CONDITIONING ENGINEERS, Pittsburgh, Pa., January 29, 1958.

MANY REFERENCES in this paper are specifically related to Pennsylvania, but many states have practically the same problems. Some areas are meeting these problems with a similar philosophy and procedure.

It is not necessary to go into details of the functions of the State Department of Public Instruction, which is responsible for the administration of all the laws of the Commonwealth with regard to the establishment, maintenance and conduct of public schools. This administration is effected through and by the Superintendent of Public Instruction.

The financing phase of school problems seems to be of interest. It is, therefore, appropiate to consider chronologically the methods of financing in the past as well as the current methods.

The initial methods of financing public schools generally and in Pennsylvania specifically were:

1. Direct taxation of real estate at the local level.
2. Per capita tax of all persons over 21 years of age.
3. Sale of general obligation bonds.

These methods of raising money at the local level had limitations placed on them by the state, but seemed to leave no serious problems until the impact of the technical way of life and the greater number of children after World War II brought home the need of new concepts in education as well as increased capacity of the schools.

There has been state aid for poorer and distressed school districts in Pennsylvania since as far back as 1870. State aid also has been common practice in certain areas of school activity since World War I. At present in Pennsylvania the following partial list indicates the magnitude of these state-aided programs.

Subsidized Activity	Dollars Per Annum
Transportation	$ 17,000,000
Special education (retarded and gifted children)	6,000,000
Instruction (mandated teachers salaries, etc.)	247,000,000
Closed school bonus	2,300,000

Driver education, extension education and recreation, milk and lunch programs, and others are also on a subsidy list.

The state-aid programs were not established to subsidize public school building projects, nor was a way apparent to meet this urgent need for public school buildings through any existing legal taxing process. With the problems being involved mostly with money, all people interested in the schools began to consider ways and means of underwriting this urgent money need.

Authority Financing

The circumstances related before, as well as financing needed for other public services, led to the consideration of an authority, as an instrument of government.

An *authority* is a body politic and corporate, used as an instrument of government to finance public work by sale of its own bonds, which are retired with rental payments from the public project financed.

Use of the authority (Fig. 1) for the financing of school building construction was inaugurated in 1947. At the same time it became legal for school districts to enter into an authority financing agreement with a municipal authority for the building and leasing of public school buildings.

Subsidy by the Commonwealth to aid in the payments of rentals was first put into law in 1949. The acts of the State legislature affecting the operation of *authorities* and the granting of subsidies have been amended until now a school district can sponsor and organize its local authority, and can lease buildings for school purposes built by non-profit organizations, profit organizations or individuals. Subsidy applies on the same basis, as prescribed by law, to all school buildings regardless of the method of financing.

The way this method of financing public school building construction has grown can be appreciated by noting that up to September 4, 1957, the State Public School Building Authority had reached a total of 350 building projects while municipal (local) authorities had at that date reached a total of 799, or a total of all authority financing of 1149 projects. How large these projects loom in the total extent of Pennsylvania public school buildings during the period from 1950 to 1957 is shown in Fig. 2. This is really big business, and as shown in Fig. 2, heating and ventilating contracts approximated $148,275,591 during the period.

Fig. 3 shows how the number of units in the Pennsylvania school building construction has grown over the years since 1920. Numbers alone do not show the basis of comparison over the period, for, as noted in Fig. 3, current school projects have increased 2 *to* 3 *times* the size of the projects prior to 1950.

Procedure for Obtaining Subsidy

When a school district decides that the expanding of its educational system is necessary, *a request for a survey* is submitted on a prescribed form to the Department of Public Instruction. This procedure is identical for all school districts, whether single districts or districts formed by jointure, union or any type of consolidation. (It is shown graphically in Fig. 4.) This procedure is applicable to any expansion of school facilities whether new buildings on new sites, new buildings on existing sites, additions to, rehabilitation or conversion of existing buildings. From information obtained by a census, by conferences with school directors and school administrators, and inspection of all physical property of the district, the survey team will make its report.

After the inspection report has been studied in the Bureau of School Buildings and after it has been approved, a consultant in the Bureau is assigned to the district, and the district is notified that the need for the project has been established. This consultant, in collaboration with specialists in the Department of Public Instruction, develops a *room schedule* which becomes the educational specifications of the project. This room schedule is specific in facilities needed, such as:

Number of conventional classrooms.
Auditorium, with seating capacity.
Gymnasium, with square feet in floor area.
Agricultural, mechanical, and other shop instructional area listed in square feet.
Music room, library, homemaking suite, etc.

After this room schedule is presented to the school district and the district completes and returns *an application for approval* of the project on a prescribed form with estimates of cost, further processing is done by the Bureau of School Buildings. The total cost of the project, along with a financial statement and an operating cost sheet of the district, is studied to determine if the applicant district has the ability to meet rental payments and meet operating costs of the new as well as the existing facilities.

If, with all the foregoing screening, the project is approved, it is placed on the approved list on a priority basis, depending on the inspection order number assigned to it when first submitted.

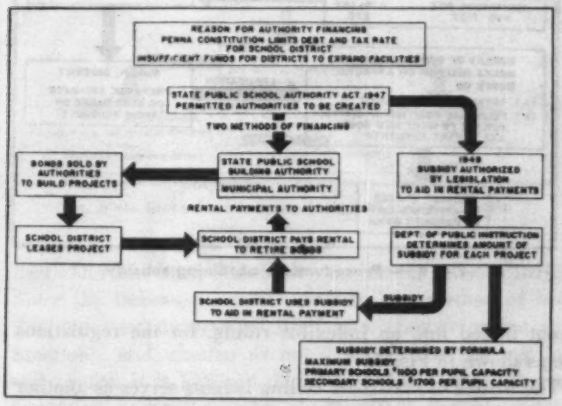

REASON FOR AUTHORITY FINANCING
PENNA CONSTITUTION LIMITS DEBT AND TAX RATE FOR SCHOOL DISTRICT
INSUFFICIENT FUNDS FOR DISTRICTS TO EXPAND FACILITIES
STATE PUBLIC SCHOOL AUTHORITY ACT 1947 PERMITTED AUTHORITIES TO BE CREATED
TWO METHODS OF FINANCING
BONDS SOLD BY AUTHORITIES TO BUILD PROJECTS
STATE PUBLIC SCHOOL BUILDING AUTHORITY
MUNICIPAL AUTHORITY
1949 SUBSIDY AUTHORIZED BY LEGISLATION TO AID IN RENTAL PAYMENTS
RENTAL PAYMENTS TO AUTHORITIES
SCHOOL DISTRICT LEASES PROJECT
SCHOOL DISTRICT PAYS RENTAL TO RETIRE BONDS
DEPT OF PUBLIC INSTRUCTION DETERMINES AMOUNT OF SUBSIDY FOR EACH PROJECT
SUBSIDY
SCHOOL DISTRICT USES SUBSIDY TO AID IN RENTAL PAYMENT
SUBSIDY DETERMINED BY FORMULA
MAXIMUM SUBSIDY
PRIMARY SCHOOLS $1000 PER PUPIL CAPACITY
SECONDARY SCHOOLS $1700 PER PUPIL CAPACITY

Fig. 1 — How Pennsylvania authority financing works

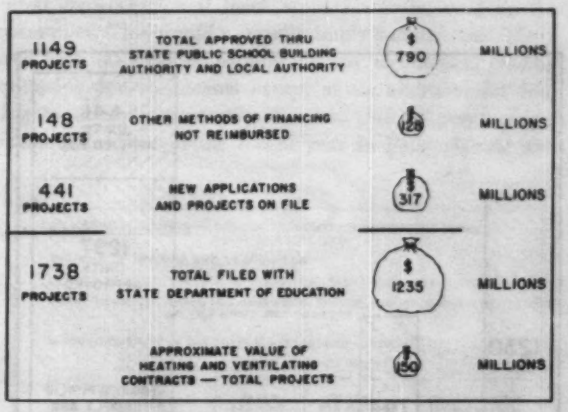


Fig. 2 — Extent of Pennsylvania public school building program, January 1950 to September 1957 (Philadelphia and Pittsburgh not included)

Regulations for Public School Building Designing

As background, it seems pertinent to understand where The State Council of Education fits into the administrative picture, what its functions are in relation to the subject being considered, and how it functions in these matters. (Fig. 5 has been prepared to show this.) The Council operates under the school laws within the Department of Public Instruction. The membership of the Council consists of the superintendent of public instruction as president and chief executive officer, with 9 appointed members. The school laws assign duties to the State Council which, in part, are:

1. Establish standards for some architectural aspects of designing for public school buildings.
2. Establish standards for designing heating and ventilating systems for public school buildings.

The law specifies that at least once in each period of 5 years the Council shall completely review and revise such standards and, in the light of changing philosophies, improve equipment and methods and make such changes as seem proper. The law also requires the governor to appoint a committee of 15 members to advise the State Council in making these revisions.

An advisory committee, appointed by the Governor, studied the problems and, on its recommendations, the Council revised the regulations, making them effective

March 4, 1955. Through other assigned duties, the Council, on recommendations of the advisory committee, created regulations covering electrical construction in all its phases, including lighting. The Council also prescribed standards for plumbing and sanitary equipment. An example of these standards applying to heating and ventilating is shown as Fig. 6.

All the regulations revised, developed and approved by the Council are primarily *performance type* regulations. They are specific and in detail only in areas where there is common agreement in the particular profession involved that these minimum standards are both adequate and reasonable. It was the intention in formulating these regulations that freedom of design be permitted so that progress in school building designing would not become static.

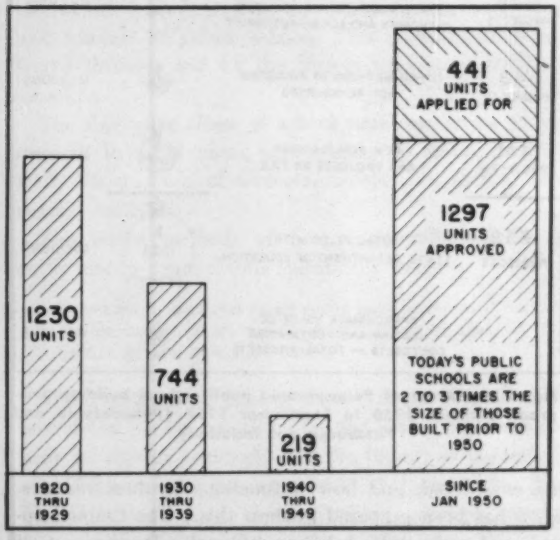


Fig. 3 — Pennsylvania public school program since 1919 (Philadelphia and Pittsburgh not included)

The hope is that new concepts, new methods, new materials and new equipment will continually improve the quality of construction in all phases of school building construction as well as introduce new economies while maintaining this acceptable level of quality. Although the regulations do not hinder designing by imposing a mandatory *straight jacket*, the Department does present ideas and recommendations to the designers. Any suggestions are the result of studies.

For example, one study disclosed that designing for heating and ventilating systems for public schools was based on an outside temperature 10 F deg lower than necessary. By taking actual Weather Bureau records in Philadelphia, Harrisburg, Scranton, State College and Pittsburgh *during the school session*, this overdesigning became obvious. A study was completed recently in which 24 existing heating and ventilating systems were redesigned and an estimate made by the original contractor on a basis of higher outside design temperatures. This study indicated that for every degree the outside design temperature was raised, the estimated contract price would be reduced approximately 1 percent. This idea, however,

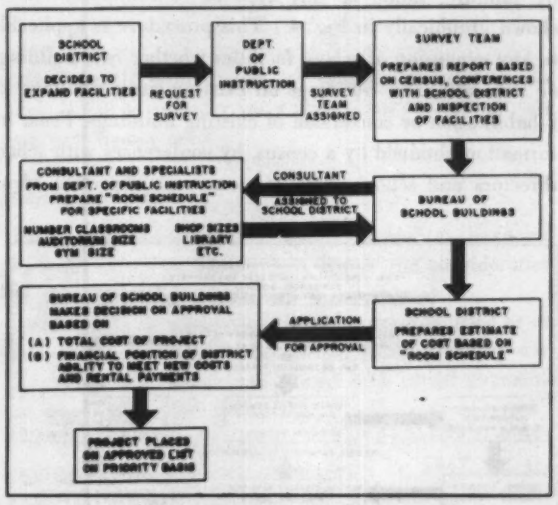

SCHOOL DISTRICT
DECIDES TO EXPAND FACILITIES
REQUEST FOR SURVEY
DEPT. OF PUBLIC INSTRUCTION
SURVEY TEAM ASSIGNED
SURVEY TEAM
PREPARES REPORT BASED ON CENSUS, CONFERENCES WITH SCHOOL DISTRICT AND INSPECTION OF FACILITIES
CONSULTANT AND SPECIALISTS FROM DEPT. OF PUBLIC INSTRUCTION PREPARE "ROOM SCHEDULE" FOR SPECIFIC FACILITIES
NUMBER CLASSROOMS
AUDITORIUM SIZE
GYM SIZE
SHOP SIZES
LIBRARY
ETC.
CONSULTANT ASSIGNED TO SCHOOL DISTRICT
BUREAU OF SCHOOL BUILDINGS
BUREAU OF SCHOOL BUILDINGS MAKES DECISION ON APPROVAL BASED ON
(A) TOTAL COST OF PROJECT
(B) FINANCIAL POSITION OF DISTRICT ABILITY TO MEET NEW COSTS AND RENTAL PAYMENTS
APPLICATION FOR APPROVAL
SCHOOL DISTRICT
PREPARES ESTIMATE OF COST BASED ON "ROOM SCHEDULE"
PROJECT PLACED ON APPROVED LIST ON PRIORITY BASIS

Fig. 4 — Procedure for obtaining subsidy

is not forced into an inflexible ruling, for the regulations are as shown in Fig. 7.

The matter of classroom ceiling heights serves as another example of studying existing regulations. Many advocates for low ceiling heights in classrooms, in order to economize on the amount of materials, made it desirable for the advisory committee for revision of the architectural regulations to study this aspect of school construction. Among other findings, this committee found that when the classroom ceiling height was lowered too much, it became more expensive to install lighting fixtures. As hanging height was reduced, spacing between rows of fixtures became less. In a conventional classroom with a ceiling height of 10 ft-6in., 9 incandescent fixtures at a cost of $309 would give certain quantitative results. Dropping the ceiling heights to 9 ft made it necessary to increase the number of fixtures to 12 at a cost of $385 to maintain the same quantity and quality of lighting. Fluorescent fixtures increased the percentage of difference. Generally the savings obtained by lowering the ceiling heights are offset by increased costs in other areas. Because of reduction of natural light along corridor walls, increased operating time of lighting fixtures increased maintenance and operating costs.

These two examples are mentioned to show that economies are sought, but only if, after study, the facts indicate the apparent savings to be real. An acceptable standard must be maintained. There is no desire to replace

satisfactory designs with doubtful substitutes. However, an open mind has been adopted and anyone is invited to discuss any theory, method or product.

There have been developments in the administration of the present regulations which may be of interest. An example is the question of electrical energy as a source of heat. This has been discussed with various school districts. Since the Bureau does not prescribe any method of heating, the question resolves itself into whether or not it is functional and whether or not it would give the required end results. It is believed that it will. After assembling information and considering all angles of the question, it was determined to be entirely a question of economics. To emphasize the uncharted field in electrical heating under the electrical rates that are presently applicable, in Pennsylvania, the school district is requested to study all facets of electrical heating and a resolution is required from the school board requesting the specific approval of the electrical heating and ventilating design.

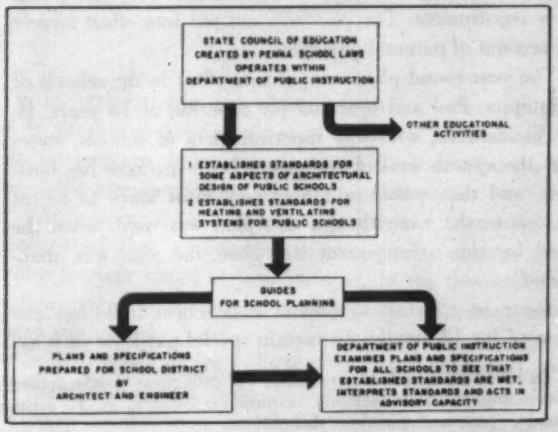

STATE COUNCIL OF EDUCATION
CREATED BY PENNA SCHOOL LAWS
OPERATES WITHIN
DEPARTMENT OF PUBLIC INSTRUCTION
OTHER EDUCATIONAL ACTIVITIES
1 ESTABLISHES STANDARDS FOR SOME ASPECTS OF ARCHITECTURAL DESIGN OF PUBLIC SCHOOLS
2 ESTABLISHES STANDARDS FOR HEATING AND VENTILATING SYSTEMS FOR PUBLIC SCHOOLS
GUIDES FOR SCHOOL PLANNING
PLANS AND SPECIFICATIONS PREPARED FOR SCHOOL DISTRICT BY ARCHITECT AND ENGINEER
DEPARTMENT OF PUBLIC INSTRUCTION EXAMINES PLANS AND SPECIFICATIONS FOR ALL SCHOOLS TO SEE THAT ESTABLISHED STANDARDS ARE MET, INTERPRETS STANDARDS AND ACTS IN ADVISORY CAPACITY

Fig. 5 — State functions in design of public schools

This procedure is followed to bring the facts into the picture and to preclude any effort on the part of any school district to evade responsibility if the operating cost is deemed to be burdensome. Several plans and specifications for electrical heating and ventilating have been approved for bidding purposes only. One project consisting of 6 elementary classrooms and auxiliary spaces has been cleared on an experimental basis for erection with electrical heating and ventilating.

Mechanical Cooling with Refrigeration in Public Schools

Present regulations (see Fig. 7) state: *Cooling and dehumidifying under some conditions is desirable but due to cost involved it is not considered feasible except in very unusual cases. When these unusual cases exist the application must be worked out with School Plant Division prior to submitting final plans. Provisions in the design may be made for the anticipated addition of equipment.*

Provisions for the future, as indicated in the regulations, mean that duct sizes and distribution arrangements required for mechanical cooling with refrigeration may become part of the construction design. The equipment may also be selected with space and arrangement for future cooling components.

The negative position taken by the Department of Public Instruction is influenced by the financial aspect. If a school district is in good financial condition and does not need State aid, approval will be given for a system of heating and ventilating, including mechanical cooling with refrigeration equipment for office, library and auditoriums. The library and auditorium cooling may be an essential consideration if these areas are to be used by the community. This would naturally imply summer use. There have been no requests to approve any mechanical cooling equipment for classrooms except as an alternate for bidding to obtain comparative figures. Due to geographical location, the time of the school year in Pennsylvania and other considerations, it is believed, as of now, that classroom cooling beyond the present provisions is not necessary nor economically feasible.

CLASS I SCHOOLHOUSES — SCHOOL BUILDINGS HAVING MORE THAN FOUR CLASSROOMS

SYSTEMS OF HEATING AND VENTILATION

CLASS I SCHOOLS SHALL HAVE MECHANICAL SYSTEMS OF SUPPLY VENTILATION

CLASS I SCHOOLS SHALL NOT HAVE ROOM STOVES, GAS FIRED UNIT VENTILATORS OR GAS FIRED UNIT HEATERS

MINIMUM QUANITY OF AIR SUPPLY — STANDARD AIR BASIS

MAJOR OCCUPIED SPACES

ROOM CLASSIFICATION	OUTSIDE AIR	TOTAL AIR	TOTAL AIR CHANGE PER HOUR
CLASSROOM STUDY ROOM LECTURE ROOM	10 CFM PER PUPIL	30 CFM PER PUPIL	NOT LESS THAN 6 AIR CHANGES
LIBRARY PLAY AREAS HOMEMAKING AUDITORIUMS GYMNASIUMS	2 AIR CHANGES	→	NOT LESS THAN 6 AIR CHANGES

(A) EFFECTIVE HEIGHT USED IN COMPUTING VOLUME OF AUDITORIUM OR GYMNASIUM IS 15 FEET PLUS ½ OF EXCESS OVER 15 FEET.

(B) VENTILATION OF OTHER SPACES ALSO SPECIFIED IN MINIMUM STANDARDS

Fig. 6 — Excerpts from *Guide for Planning School Plants in Pennsylvania* (adopted 1955) covering minimum standards and recommended practices

This concept of the need for complete mechanical cooling in classrooms would require new study and consideration when and if year-round use of school buildings for regular classes became a reality. Use of school facilities on a year-round basis has been discussed as a way of meeting the current educational crisis.

The Conference of Governors at Williamsburg, Va., June 23-26, discussed this possibility. The Council of State Government has proposed:

1. To add a summer school, with special curricular offerings and with optional attendance.
2. To conduct regular school classes on a year-round basis with each student attending 3 of the 4 quarters in a staggered system.

3. To conduct classes year-round but with attendance required for all 4 quarters with a short vacation period.

The Governor of South Carolina announced that the Legislature of South Carolina had voted to set up an experiment to find out:

1. Do the children like it?
2. Do the teachers like it?
3. Do the parents like it?
4. How much money will it save?
5. What effect will it have on education?

This idea of year-round use of school buildings has been studied before and tried before. The Atlanta (Georgia) area, prior to creating new bond issues for new school buildings for Atlanta, Fulton County and Dekalb County, appointed a committee to study this year-round plan from all angles. This committee worked for 5 months and reported their findings to be that the 12-month plan would:

1. Cost more.
2. Be bad for pupils and teachers.
3. Suit nobody, particularly the parents.

An interesting item is that the air-conditioning equipment cost, if the 12-month plan were used, was placed at $1,319,000. This air-conditioning item raised some questions, but Dr. MacRae of Fulton County, Georgia, stated, *We do not hesitate to say that air conditioning for a regular summer session of school in this climate is an imperative.*

It is believed that Dr. MacRae's observation for Georgia would be true in most parts of the United States of America if schools were in session in the summer time.

In Fairfield, Conn., several years ago, the year-round plan was studied with the conclusion that it would be economical even with air conditioning which they felt would be a requirement. The plan was *not* put into effect largely on account of parental objection.

The year-round plan was put into effect in the schools of Aliquippa, Pa., and operated for a period of 10 years. H. R. Vanderslice, who was superintendent of schools, states that the system worked and that schools are now big business, and that school administrators must learn to adjust to new needs. Even though this plan was used, when the need for this arrangement was gone, the plan was abandoned.

There is growing agreement that school buildings can be used for 12 months for certain special purposes such as:

1. Full 12-month school attendance for delinquent youths in lieu of commitment to correctional institutions. Newark, N. J., maintained a year-round school for this purpose.
2. Use 12-month schools as a speed-up and enrichment program for gifted children.
3. There is general agreement that all advanced institutions, including junior colleges, existing and contemplated, will, in the near future, be on a full 12-month schedule.

If progress and the plane of living continue in the same direction as now and with the same speed, complete air conditioning in all occupied areas in public schools will be considered a necessity even for the present schedule of sessions. When this time comes, a new concept of architectural designing must be considered. The buildings now being built with limited insulation and large glass areas must give way to buildings designed to reduce the first cost of air-conditioning equipment but, more particularly, to keep the operating costs low.

Until we spend at least as much for education as is now spent separately for nonessentials, such as cosmetics, whiskey and tobacco, and until there is a program for child education and development that at least is comparable to research and study of the best methods of production of wheat, cattle and swine, we still have lots to do for our children.

CAPACITY OF HEATING AND VENTILATING EQUIPMENT

THE EQUIPMENT IN ANY LOCALITY SHALL BE SUFFICIENT TO SATISFY OFFICIAL REQUIRMENTS AT ALL TIMES WHEN THE OUTSIDE TEMPERATURE IS WITHIN THE RANGE: (A) UPPER LIMIT, 55 DEGREES FAHRENHEIT (B) LOWER LIMIT PLUS 10 DEGREES FAHRENHEIT OR THAT TEMPERATURE WHICH AFTER STUDY OF THE LAST 20 YEARS RECORD OF THE WEATHER BUREAU SEEMS TO BE APPLICABLE DURING SCHOOL SESSION

COOLING AND DEHUMIDFYING

COOLING AND DEHUMIDFYING UNDER SOME CONDITIONS IS DESIRABLE BUT DUE TO COST INVOLVED IT IS NOT CONSIDERED FEASIBLE EXCEPT IN VERY UNUSUAL CASES. WHEN THESE UNUSUAL CASES EXIST THE APPLICATION MUST BE WORKED OUT WITH SCHOOL PLANT DIVISION PRIOR TO SUBMITTING FINAL PLANS. PROVISIONS IN THE DESIGN MAY BE MADE FOR THE ANTICIPATED ADDITION OF EQUIPMENT

Fig. 7 — Excerpts from *Guide for Planning, 1955* covering minimum standards and recommended practices for heating and ventilating and for cooling and dehumidifying

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Economics of School Heating and Air Conditioning

By

Z. A. Marsh

The author is Director of School Activities, Minneapolis-Honeywell Regulator Co., Minneapolis, Minn. A presentation at the Symposium on School Heating, Ventilating and Air Conditioning at the 64th Annual Meeting of the AMERICAN SOCIETY OF HEATING AND AIR CONDITIONING ENGINEERS, Pittsburgh, Pa., January 29, 1958.

AIR CONDITIONING, as defined by this Society, is the process of treating air so as to control *simultaneously* its temperature, humidity, cleanliness and distribution to meet the requirements of the conditioned space.

Fortunately, more and more people are beginning to understand that a complete air-conditioning system provides for *year-round* air conditioning. In the discussion to follow, only year-round air-conditioning installations have been considered.

School buildings are built to keep out the elements and to create an environment for teaching and for learning. Without the building, this environment cannot be created. Without the proper environment, there is no purpose in constructing the building.

Every day the creation of a suitable and adequate environment becomes more important to the comfort, health, and productivity of students and to the efficiency of the school staff.

Educators know that students learn more quickly in an environment that is properly controlled. And this is particularly true of children who may learn to read twice as fast in classrooms at 70 F as at 80 F.

Humans seem to tire more quickly when working in a warm humid environment than in a cool one. This is true, physiologists say, because working in high temperatures produces more stress. Fatigue appears sooner. If people stay in surroundings with a temperature above 90 F, their bodies do not return to lower physiological levels even when they rest.

And when people are too tired, they work more slowly and with effort. Yet more mistakes are made. In industry, for example, fatigued workers are a safety hazard to themselves and to others. They wreck the teamwork so essential to smooth running production lines. From the human standpoint, these workers are likely to be unhappy because they are overtired. And eventually, their health as well as their morale may be affected.

For all these reasons, more people are changing the question *What will air conditioning cost?* to *What will it cost to be without air conditioning?* This approach is thought to be more realistic.

Only during the past few years have limited studies been conducted to prove that air conditioning is essential not only in offices, hospitals and manufacturing plants, but also in schools in order to improve the efficiency, productivity, health, and learning rate of the occupants.

As yet, there is very little sound scientific data to prove the percentage increase in office and factory workers' efficiency and productivity or the speed of recovery of hospital patients, much less the improvement in the learning of students through the use of air conditioning.

Fig. 1 shows results of 8 case studies, taken from published reports. The data do indicate that there is a positive correlation between air conditioning and increased working efficiency. It should be noticed that increases in efficiency in office buildings vary from 20 percent to more than 50 percent, and in factories from 22 to 28 percent.

Fig. 2 presents data as reported in published literature indicating that air conditioning reduces absenteeism—from 27 to 30 percent in office buildings, and in 75 factories a similar amount. This matter of absenteeism is especially important in public schools where the revenue of the school is in many cases determined by student attendance. Air conditioning has also been reported to have caused cuts in labor turnover and increased church attendance as shown in Fig. 2.

The writer believes that in the near future, scientific data will be available which will permit predicting in advance not only the increased efficiency and productivity of workers and the improved recovery of hospital patients, but also the improvement in the learning rate of students through the use of air conditioning. Controlled environment in the classroom will become as important from the standpoint of health and learning efficiency as it already is from the standpoint of comfort.

Nathaniel Glickman has prepared a very complete program at the ASHAE Laboratory in Cleveland which should produce the scientific data needed to prove conclusively that air conditioning pays for itself. This program is underway and reports should be forthcoming in the early future.

In 1954, a task group of mechanical engineers from the Federal Construction Agencies was appointed to determine, with the cooperation of the Building Research Advisory Board, the necessity of air conditioning in Federal Buildings. The resulting report, issued in 1955, stated: "Almost everyone agrees that air conditioning is worthwhile, but concrete evidence by which management can justify it

does not appear to be available. Aside from the merits of air conditioning, it is rapidly becoming an accepted necessity. Additional work output of employees is not enough. Other factors must also be considered. These include: health, reduced absenteeism, good will, and lower personnel turnover. Only quality design and equipment should be considered. Central air conditioning will generally cost less than individual room units."

Everyone working in the area of educational housing must consider the economics of air conditioning just as the Federal Government Task Force did. And it is true that the lack of broad and factual proof of the economic advantages has slowed down the acceptance of year-round air conditioning. While the preceding case studies show efficiency increases of up to 51 percent, it may be difficult to believe them because of their very size. And it may seem doubly difficult to apply them to schools. When deciding whether or not year-round air conditioning should be included, many factors must be considered, such as:

1. Economics from the standpoint of human efficiency increase in performing daily tasks in the building;
2. Economics of reduced personnel turnover and training due to improved working conditions;
3. Economic ability to compete better for personnel due to improved environmental conditions;
4. Economics of initial cost and the cost of owning and operating the air-conditioning system;
5. Economic value of increased comfort as it affects students and administrative employees;
6. Economics of reduced cleaning costs and preservation of interiors and supplies.

In addition to these factors, there are many other considerations — both tangible and intangible — not the least of which is health. However, if one can determine what efficiency increase is necessary for the installation to be economically profitable, a decision can be made based on this gain plus all the other factors such as reduced personnel turnover.

Recently figures have been developed which show in startling fashion the relatively small human efficiency increases required to make year-round air conditioning economically justifiable in various types of new buildings. Even though this study of the economics of air conditioning has not been completed, representative information can be presented and Fig. 3 shows the information for new school buildings.

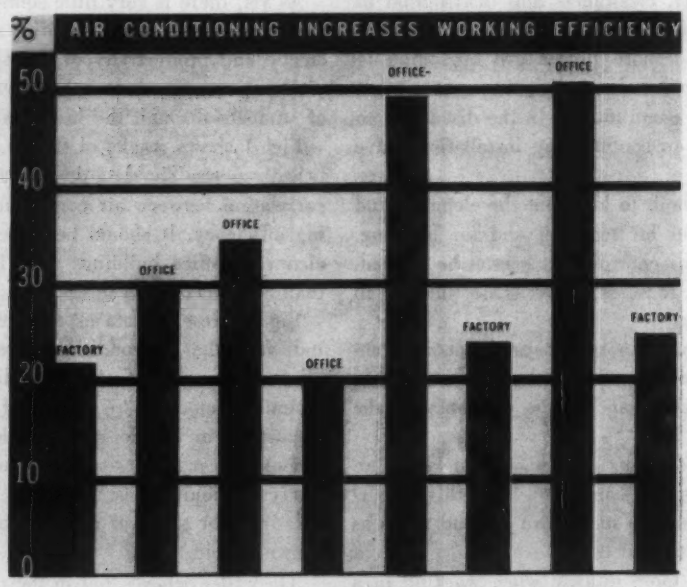

Fig. 1—Results of 8 case studies from published reports showing increases of working efficiency following installation of air conditioning in factory and office buildings.

In Fig. 3 the cost of a new school building is based upon today's construction costs. No tax cost is included since there are no taxes on school buildings, and the insurance is estimated at 1 percent.

Air-conditioning cost as shown in the diagram is based upon a year-round central fan system with a 20-year life, as recommended by the ASHAE GUIDE, with 5 percent of the original cost added for interest and 1 percent for insurance and taxes. The air-conditioning costs do not include the heating costs nor the cost of the heating equipment because the attempt is to compare the additional cost of year-round air conditioning beyond the cost of a conventional heating system. These are average air-condi-

tioning costs, and will vary somewhat with the design and geographical location of the building.

The data in Fig. 3 indicate that in a typical new school, the annual cost per square foot of owning and operating the classroom area, including heating and ventilating, is $2.21 or 23.7 percent of the total cost. Equipment and

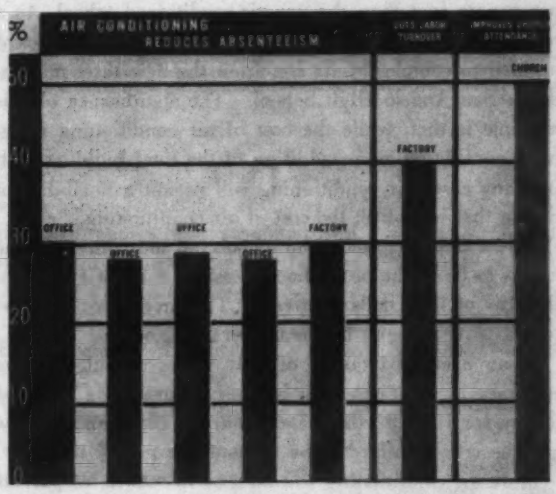

Fig. 2—Data as reported in published literature indicating reduction in absenteeism, in labor turnover, and in increased church attendance following installation of air conditioning.

supplies account for 32 cents or 3.4 percent of the total cost. The payroll in the classroom area is the largest expense, amounting to $6.52 or 70.1 percent of the total.

The additional cost of owning and operating a complete and flexible classroom air-conditioning system, on the basis of a nine-month season in the north temperate zone, is 26 cents per square foot or 2.8 percent of the total cost. This is 4 percent of the payroll, which means that if the teaching efficiency is increased only 4 percent, the air conditioning will pay for itself. And if looked at in terms of the increase in learning rate required to pay for air conditioning, the percentage is even less.

It is difficult to put a price tag on education. What is education worth? This is always a frustrating question, because it is impossible to put down on paper how much value education is going to be to a student at the time he is receiving the education. However, the writer believes that a price tag can be put on education—a price tag that is in keeping with the standard method of evaluation of prices of things and of values of things.

Take a pencil, for example. One can't say what an ordinary pencil is worth because it might be used to write a book that would be worth thousands of dollars. Was the pencil worth that amount? Or was the pencil worth 5 cents because that is what it cost? This illustrates the habit of putting price tags on things, not for what they will profit the user, but what they cost him. And, as such, a price tag can be put on education. One doesn't know what it will bring or what profit will result but its cost is known and can be worked with from a total standpoint and also from the standpoint of the various parts of the cost.

If the value of education is established as the yearly cost of keeping a student in school, a 2.3 percent increase in learning is all that is needed to justify air conditioning. It must be remembered that the only purpose of the school building is the education of the student. And one must think of that building only in terms of its ability to provide more education.

Educators estimate that the amount learned by the average student will increase from 15 to 60 percent in a proper thermal environment. If one realizes how this improved education compounds over the years, air conditioned schools will be considered very desirable for the future.

In regard to the air conditioning system itself, if a less than complete system is installed at a first cost saving of

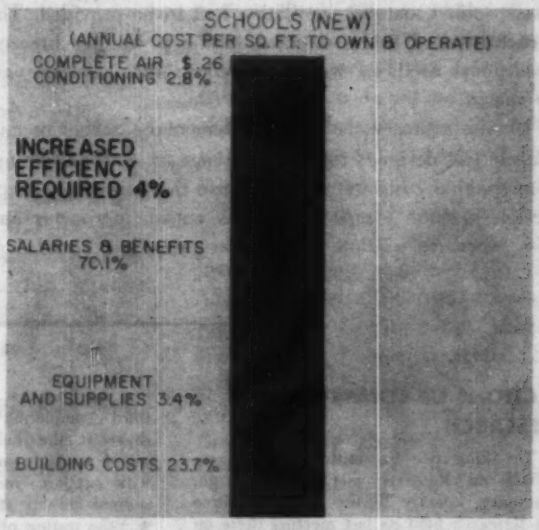

Fig. 3—Analysis of annual cost of owning and operating new school buildings. Salaries and benefits = $6.52 = 70.1%; Equipment and supplies = $0.32 = 3.4%; Building costs = $2.21 = 23.7%; and complete air conditioning = $0.26 = 2.8%.

20 percent, the annual cost per square foot would be 24 cents, which is 2.6 percent of the total cost. The addition of only 0.2 percent in the total cost would pay for a complete and flexible air-conditioning system.

The author feels sure that everyone here can think of many air-conditioning installations where the shaving of the budget left the school with a system which would not provide the thermal environment needed or expected. The cost difference was probably quickly eaten up on mental

anguish and recriminations against designer and contractor alike, let alone costly call-backs and compromises with desired results. Unless the system is complete and provides all conditions required to meet the definition of year-round air conditioning, both the school and the community will lose in the long run.

One may tend to disbelieve some of the claims heard and read about the increases of human efficiency and productivity resulting from the use of air conditioning. Therefore, the approach taken here is intended to point out how small this increase in human efficiency need be in order that the installation of air conditioning will pay for itself. And the economic potentialities of *designing* for air conditioning have not even been considered.

As an example, consider the case of San Angelo, Tex., where several years ago 5 elementary schools were built. Four were designed without air conditioning. One was *designed* to take advantage of air conditioning. Contracts for all were let on the same date with the same contractors bidding.

Mr. Wadzeck's paper presented at this Symposium indicated that in those 4 schools, because air conditioning was not specified, natural ventilation had to be provided. The structures had to be oriented to the prevailing breezes. Additional facilities were required to direct outside air to spaces.

On the contrary the Belaire Elementary School at San Angelo *was* designed to take advantage of air conditioning. Construction costs were low because the unique pie-shape design is more compact with less outside perimeter and less expensive window fenestration (see Figs. 3 and 4 of Mr. Wadzeck's paper). At least 50 percent of the normal ductwork was eliminated, and ducts are short and similar. Mechanical equipment is located in a central basement. Operating costs have been cut by dramatic window shading and by pre-cooling the entire building with 100 percent night air that is not refrigerated.

When the bids were taken and analyzed it was found that Belaire, the air-conditioned school, cost 8 percent less per square foot than the non-air-conditioned school. As a result of this experience, the San Angelo School Board decided to completely air condition the new three-million-dollar San Angelo High School. The significance of this example is that, while the cost of air conditioning is usually considered as an addition to the total building cost, in many cases air conditioning will permit a flexibility of design that will offset the cost of air conditioning.

To get the most out of the schools, all must intensify the efforts to build the best schools possible and not give in to the fear of total dollars invested. The investment must be put in perspective to the total operating costs.

If an average increase of only 4 percent in teaching efficiency or 2.3 percent in increased learning is required to pay for fully flexible year-round air conditioning, how can the schools afford to be without it?

More air conditioning will be seen in schools as parents and the public appreciate its importance as a teaching aid and as they learn that air conditioning will add very little expense to the over-all cost of education. The trend toward the year-round use of schools, either as classrooms or for other community purposes, demands year-round air conditioning.

ACTIONS OF COMMITTEE ON RESEARCH

The Executive Committee of the Committee on Research met at Pittsburgh, Saturday, January 25, the 1957 Committee on Research held its last meeting there on Sunday, January 26th. Among the actions taken at the latter meeting were the following.

The Committee asked (and later received) permission of the Council to put its new regulations on TAC membership into effect over a 3-year period • • • the Committee recommended the renewal of the research contract with the University of Minnesota, covering the project on solar collectors to cover the current year • • • approval was given to a recommendation of the TAC on Hot Water and Steam Heating that a research project be started to determine the steam, steam-condensate flow and heat transfer relationship of small size plain and finned non-ferrous and ferrous tubing and piping • • • it was reported that an intensive effort is being made toward completing the new environment room at the Laboratory • • • a sound (noise) program, being carried on with support from the Navy, is an important activity at the Laboratory • • • the testing phase of the odor program is substantially completed • • • a revolving door for use in the infiltration project is to be set up to permit tests on the infiltration through such doors, using the helium tracer gas method • • • ten cooperative projects are in active operation.

At its organization meeting, the new 1958 Committee also took actions and received information of general interest to members.

The Technical Advisory Committee on Panel Heating and Cooling was discontinued having completed its work • • • a new TAC on Physiological Research and Human Comfort was authorized to combine the work of the 2 earlier TAC's on Physiological Research and on Sensations of Comfort • • • consideration was given to making available the translation of a Russian monograph on solar energy • • • approval was given to a recommendation of the TAC on Combustion, asking that the Laboratory make a literature study on the ventilation requirements for fuel-burning equipment used in residential and commercial installations • • • the Committee considered setting up a TAC on Controls, and plans are being prepared for an all-industry conference on this subject.

ASA STANDARD ON SOUND

Newly published as an American Standard is the booklet *Laboratory Measurement of Air-Borne Sound Transmission of Building Floors and Walls.* (*ASA* number is Z24.19-1957). The booklet is highly technical and intended to cover laboratory measurements only. It is available through *American Standards Association,* 70 East 45th St., New York, N. Y.

P. B. Gordon

Report of

The 64th Annual Meeting

Concerning

Technical Features and Functions

E. R. Queer

The 7 sessions of the ASHAE 64th Annual Meeting at Pittsburgh, Pa., January 27-29, 1958, featured the presentation of technical papers. The greater part of the program at each session was devoted to their presentation and discussion. Included was 1 topical session and 2 symposium-type sessions. Also there were various special events including the Annual Welcome Luncheon, the Life Members' Luncheon, the Past Presidents' Dinner and the Annual Banquet. There was a special Ladies' Program. Three inspection trips were included. The Council and numerous technical committees held meetings. These features and functions are reported here.

During the course of the 7 sessions at the Annual Meeting, a total of 17 technical papers was presented and there were 10 papers on the program at the 2 symposium sessions.

First Session, Monday, Jan. 27, 9:00 a.m.

With Pres. P. B. Gordon, New York, N. Y., presiding, the Topical Session on Solar Energy, which was the subject of this session, was conducted under the chairmanship of Dr. R. C. Jordan, Minneapolis, Minn.

Four papers had been programmed for this session, with the following titles and authors.

Direct Solar Radiation Available on Clear Days, by J. L. Threlkeld and R. C. Jordan (published in the ASHAE JOURNAL SECTION, *Heating, Piping & Air Conditioning*, December 1957, p. 135) was presented by Dr. Threlkeld.

A High-Flux Low-Temperature Solar Collector, by R. G. Nevins and P. E. McNall, Jr. (published in the ASHAE JOURNAL SECTION, *Heating, Piping & Air Conditioning*, November 1957, p. 171) was presented by Professor Nevins.

Performance of a Solar Heated Office Building, by F. H. Bridgers, D. D. Paxton and R. W. Haines (published in the ASHAE JOURNAL SECTION, *Heating, Piping & Air Conditioning*, November 1957, p. 165) was presented by Mr. Bridgers.

Sun Energy Assistance for Air-Type Heat Pumps, by C. P. Davis Jr., and R. I. Lipper (published in the ASHAE JOURNAL SECTION, *Heating, Piping & Air Conditioning*, December 1957, p. 123) was presented by Mr. Davis.

The papers were discussed by the following people: H. Tabor, Jerusalem, Israel; D. T. Donovan, Tyler, Tex.; H. H. Reich, Pittsburgh, Pa.; F. R. O'Brien, Birmingham, Ala.

Second Session, Tuesday, Jan. 28, 9:30 a.m.

First Vice Pres. E. R. Queer, University Park, Pa., presided at the second session, and H. A. Lockhart, Morton Grove, Ill., as chairman of the Committee on Research, presented the report of that Committee (report can be found on pp. 215-222, of the January issue, ASHAE JOURNAL SECTION, *Heating, Piping & Air Conditioning*).

The first paper, Cooling Load from Thermal Network Solutions, by Harry Buchberg (published in the ASHAE JOURNAL SECTION, *Heating, Piping & Air Conditioning*, October 1957, p. 131) was presented by S. F. Gilman, Syracuse, N. Y.

The second paper, The ASHAE Air-Borne Dust Survey, by K. T. Whitby, A. B. Algren, R. C. Jordan

Here are the speakers who presented their papers at the 1st and 2nd sessions. *(l. to r.) Below:* F. H. Bridgers, C. P. Davis, R. G. Nevins and J. L. Threlkeld. *Right:* K. T. Whitby, L. G. Seigel and H. A. Lockhart

and J. C. Annis (published in the ASHAE JOURNAL SECTION, *Heating, Piping & Air Conditioning*, November 1957, p. 185) was presented by Dr. Whitby.

The third paper, Natural Convection Cooling and Dehumidifying, by L. G. Seigel and W. L. Bryan (published in the ASHAE JOURNAL SECTION, *Heating, Piping & Air Conditioning*, December 1957, p. 129) was presented by Professor Seigel.

The fourth paper, Stable Hot-Wire Anemometer for Low Speeds, by J. F. Kemp (published in the ASHAE JOURNAL SECTION, *Heating, Piping & Air Conditioning*, October 1957, p. 137) was presented by title only.

The papers were discussed by the following people: H. B. Nottage, Encino, Calif.; Lorne W. Nelson, Minneapolis, Minn.; G. V. Parmelee, Dhahran, Saudi Arabia; R. F. Logsdon, Louisville, Ky.; W. C. L. Hemeon, Pittsburgh, Pa.; and W. L. Batchelor, New Britain, Conn.

Third Session, Tuesday, Jan. 28, 9:30 a.m.

A panel of 5 speakers assembled for this Symposium on High Temperature Water. Second Vice Pres. A. J. Hess, Los Angeles, Calif., presided and P. N. Vinther, Dallas, Tex., was moderator. The 5 papers can be found substantially in full in the ASHAE JOURNAL SECTION, *Heating, Piping & Air Conditioning*.

Authors of papers at 4th session (l. to r.): L. F. Schutrum, R. G. Nevins and T. C. Min

Economic Evaluation of High-Temperature Water, by E. M. Thompson is in this issue on p. 140.

Marine Application of High-Temperature Water, by S. W. Brown is in the March issue on p. 161.

Design of High-Temperature Water Systems for Military Installations, by C. A. Carter and B. L. Sturdevant is in the February issue on p. 109.

Heating & Air Conditioning a Civilian Airport, by Charles Broder is in the March issue on p. 147.

British and European Design and Construction Methods, by George Applegate, Jr., is in the March issue on p. 169.

Written and oral discussions of the papers were presented by M. A. Benson, Pittsburgh, Pa.; J. R. Carroll, Urbana, Ill.; P. L. Geiringer, Long Island City, N. Y.; E. G. Hansen, New York, N. Y.; O. S. Lieberg, New York, N. Y.; D. Lorne Lindsay, Montreal, Que., Canada; F. A. Traugott, Syracuse, N. Y.; and G. Lorne Wiggs, Montreal, Que., Canada.

The panel at the Symposium on High Temperature Water (3rd session). (l. to r.) Front: Charles Broder, S. W. Brown, B. L. Sturdevant. Rear: George Applegate, Jr., E. M. Thompson, and C. A. Carter

It is planned to publish the 5 symposium papers just mentioned in full in a separately printed bulletin, together with the discussions. It is not expected that these symposium papers will be printed in the TRANSACTIONS.

Fourth Session, Wednesday, Jan. 29, 9:30 a.m.

Pres. P. B. Gordon presided at the fourth session during which 3 programmed papers were presented and discussed.

Effect of Heated-Floor Temperatures on Comfort, by R. G. Nevins and A. O. Flinner (published in the ASHAE JOURNAL SECTION, *Heating, Piping & Air Conditioning*, October 1957, p. 149) was presented by Professor Nevins.

Lighting and Cooled Air Effects on Panel Cooling, by L. F. Schutrum and T. C. Min (published in the ASHAE JOURNAL SECTION, *Heating, Piping & Air Conditioning*, November 1957, p. 177) was presented by Mr. Schutrum.

Radiant Drafts from Cold Ceilings, by H. E. Ronge and B. E. Lofstedt (published in the ASHAE JOURNAL SECTION, *Heating, Piping & Air Conditioning*, September 1957, p. 167) was presented by C. M. Humphreys, Cleveland, Ohio.

These papers brought forth discussions by C. M. Ashley, Syracuse, N. Y.; D. R. Bahnfleth, Urbana, Ill.; W. P. Chapman, Milwaukee, Wis.; M. K. Fahnestock, Urbana, Ill.; Aldo

Gini, Milan, Italy; L. P. Herrington, New Haven, Conn.; W. C. Kadow, Chicago, Ill.; F. J. Linsenmeyer, Detroit, Mich.; R. W. McKinley, Pittsburgh, Pa.; R. P. Schoenijahn, Wilmington, Del.; B. R. Small, Pittsburgh, Pa.; W. F. Spiegel, Philadelphia, Pa.; Walter Sturrock, Cleveland, Ohio.

The authors and the presiding officer at the 5th session (*l. to r.*): A. J. Hess, C. H. Pesterfield, T. L. Etherington and F. A. Joy

Fifth Session, Wednesday, Jan. 29, 9:30 a.m.

This session was called to order by Treas. C. H. Pesterfield, E. Lansing, Mich. There were 3 papers.

Local Climatic Weather Data, by W. L. Holladay (published in the ASHAE JOURNAL SECTION, *Heating Piping & Air Conditioning*, January 1958, p. 201) was presented by A. J. Hess, Los Angeles, Calif.

A Dynamic Heat Storage System, by T. L. Etherington (published in the ASHAE JOURNAL SECTION, *Heating, Piping & Air Conditioning*, December 1957, p. 147) was presented by Mr. Etherington.

Improving Attic Space Insulating Values, by F. A. Joy (published in the ASHAE JOURNAL SECTION, *Heating, Piping & Air Conditioning*, January 1958, p. 223) was presented by Professor Joy.

Discussions, both written and oral, were presented by Gen. W. A. Danielson, Memphis, Tenn.; M. L. Ghai, Evendale, Ohio; R. H. Heilman, Pittsburgh, Pa.; H. E. Robinson, Washington, D. C.; R. G. Vanderweil, Boston, Mass.; Warren Viesmann, Baltimore, Md.; J. R. Watt, Austin, Tex.

Sixth Session, Wednesday, Jan. 29, 2:00 p.m.

At this session, which was presided over by 1st Vice Pres. E. R. Queer, 3 technical papers were presented and discussed.

Chimney and Stack Design for Gas-Fired Equipment, by R. L. Stone (published in the ASHAE JOURNAL SECTION, *Heating, Piping & Air Conditioning*, October 1957, p. 143) was presented by Mr. Stone.

Pressure Losses and Flow Characteristics of Multiple-Leaf Dampers, by E. J. Brown and J. R. Fellows (published in the ASHAE JOURNAL SECTION, *Heating, Piping & Air Conditioning*, August 1957, p. 119) was presented by Mr. Brown.

Fan Noise Variation with Changing Fan Operation, by R. D. Madison and J. B. Graham (published in the ASHAE JOURNAL SECTION, *Heating, Piping & Air Conditioning*, January 1958, p. 207) was presented by Mr. Graham.

The following presented discussions both written and oral: P. R. Achenbach, Washington, D. C.; C. M. Ashley, Syracuse, N. Y.; C. L. Benn, Pittsburgh, Pa.; Joseph Burges, Dumont, N. J.; J. B. Chaddock, Troy, N. Y.; S. F. Gilman and O. W. Clausen, Syracuse, N. Y.; Arthur Harrington, Stoneham, Mass.; W. F. Kerka, Cleveland, Ohio; W. B. Kirk, Cleveland, Ohio; J. N. Livermore, Detroit, Mich.; Raymond Mancha, Pittsburgh, Pa.; H. B. Nottage, Encino, Calif.; Leonard Phillips, Hartford, Conn.; C. G. Segeler, New York, N. Y.; H. E. Straub, Waterloo, Ia.; H. E. Ziel, Detroit, Mich.

Seventh Session, Wednesday, Jan. 29, 2:00 p.m.

This session was a Symposium on School Heating, Ventilating and Air

Below are authors of papers presented at the 6th session and the presiding officer at the session (*l. to r.*): R. L. Stone, R. D. Madison, E. R. Queer, J. B. Graham and E. J. Brown

The authors and moderator before the Symposium on School Heating, Ventilating and Air Conditioning (7th session) (*l. to r.*): C. E. Hershey, Henry Wright, E. G. Good, W. G. Hole, G. B. Wadzeck, Z. A. Marsh

Conditioning, with Pres. P. B. Gordon presiding. W. G. Hole, Montreal, Que., Canada, acted as moderator. Five papers were prepared for this symposium and each was presented by its author.

One of these papers, entitled HV&AC Design Practice for Schools, by Henry Wright (published in the ASHAE JOURNAL SECTION, *Heating, Piping & Air Conditioning*, February 1958, p. 137).

The others, namely: Educator's View of Need for Good Classroom Environment, by G. B. Wadzeck; Economics of School Heating and Air Conditioning, by Z. A. Marsh, and State Board Problems—Financing and Others, by C. B. Hershey, can be found in this issue of the JOURNAL SECTION. Looking into the Future, by E. G. Good, is scheduled to appear in the May issue.

Written and oral discussions of the papers were presented by R. L. Boyd, Pittsburgh, Pa.; J. W. Kreuttner, New York, N.Y.; T. F. Rockwell, Pittsburgh, Pa.; and P. H. Yeomans, Philadelphia, Pa. It is planned to publish these 5 symposium papers just mentioned in full in a separately printed bulletin, together with the discussions. It is not expected that these symposium papers will be printed in the TRANSACTIONS.

Past Pres. John W. James hands the past President's Award to Pres. P. B. Gordon

Honors and Awards

Honoring of outstanding members is one of the features of each Annual Meeting. Two forms of honor established by gifts or endowments are the F. Paul Anderson Award consisting of a gold medal and citation, and the ASHAE-Homer Addams Award consisting of a scholarship for graduate work and a certificate. Each is made no oftener than once a year.

Each year too, the retiring president receives the Past President's Award from his predecessor in that office.

In Pittsburgh at their luncheon meeting, life members decided to award a plaque to Prof. Linn Helander to convey their regard for his work in this field. This award was made at a meeting of the Kansas City Chapter on February 3 (see p. 167.

Prof. G. L. Tuve, recipient of the 16th award of the F. Paul Anderson Medal. The citation read: Engineer, educator, researcher and author, who has performed noteworthy services for the engineering profession and for the benefit of the general public by training men in heating, ventilating, cooling and air conditioning and through his dedication to research in these arts and sciences

Paul K. Addams presents the certificate covering the 2nd ASHAE-Homer Addams Award to W. E. Springer, a graduate student at the University of Illinois

Special Events and Functions

Supplementing the technical sessions, the Committee on Arrangements of the Pittsburgh Chapter prepared a program to take care of the interests of all in attendance. This included a series of events for the ladies with a tea and entertainment, and a bus tour of the city. For everyone, there were inspection trips on 2 afternoons.

At the Opening Luncheon on Monday, certificates were awarded to the newly-elected Fellows: A. L. Baum, New York, N. Y.; A. C. Buensod, New York, N. Y.; C. F. Kayan, New

York, N. Y.; I. W. Cotton, Indianapolis, Ind.; E. L. Crosby, Baltimore, Md.; E. P. Heckel, Chicago, Ill.; F. B. Rowley, Minneapolis, Minn.; and G. M. Simonson, San Francisco, Calif.

In accordance with custom, the Annual Banquet on Wednesday evening included not only the address by Allison R. Maxwell, Jr., Pittsburgh, Pa., but also was the occasion for the installation of the new Officers and the presentation of the F. Paul Anderson Medal and the Past President's Award. Thomas Pratt, Pittsburgh architect, acted as toastmaster, with the Invocation being given by Dean N. R. H. Moor, D.D., Trinity Episcopal Cathedral, Pittsburgh.

At the Welcome Luncheon, Monday noon, Toastmaster T. F. Rockwell presented Pittsburgh's Mayor, the Honorable David L. Lawrence, who told of *Pittsburgh, A City Where Dreams Come True.* (l. to r.) Pittsburgh Chapter Pres. E. H. Riesmeyer, Jr. and Pres. P. B. Gordon as they greet the arriving mayor

The Past Presidents' Dinner was held on Tuesday evening. *(l. to r.) Seated:* Pres. P. B. Gordon, Past Presidents John W. James and John E. Haines. *Standing:* Past Presidents L. N. Hunter, Reg. F. Taylor, W. L. Fleisher, F. B. Rowley, M. F. Blankin, G. L. Tuve and S. H. Downs

Each year, the Annual Meeting permits a review of the Society Research Program and activities, and much advance planning is carried on. This is done through meetings of the Committee on Research and its Technical Advisory Committees.

The Executive Committee of the Committee on Research met on Saturday and this was followed by the meeting of the entire Committee on Sunday. On both Monday and Tuesday afternoons and Tuesday evening,

THE HEAD TABLE GROUP — BEFORE THE ANNUAL BANQUET

***(l. to r.) Front:* Mrs. T. F. Rockwell, Mrs. A. J. Hess, A. J. Hess, Mrs. E. R. Queer, E. R. Queer, Mrs. P. B. Gordon, Allison R. Maxwell, Jr., Mrs. G. L. Tuve, G. L. Tuve, Mrs. E. H. Riesmeyer, Jr., *Rear:* Dean N. R. H. Moor, D.D., John W. James, D. W. Loucks, Walter A. Grant, Mrs. Walter A. Grant, P. B. Gordon, Mrs. Thomas C. Pratt, T. C. Pratt, T. F. Rockwell, E. H. Riesmeyer, Jr. C. H. Pesterfield and Mrs. Pesterfield were unexpectedly called home before the Banquet**

JOURNAL SECTION

meetings of the various Technical Advisory Committees were in session. Since these meetings are generally open to all, they attract attendance of many who are not members of the committees but who are interested in hearing and taking part in their discussions.

Technical Advisory Committees which held meetings included Air Cleaning, Heat Transfer through Fenestration, Hot Water and Steam Heating, Sorption, Heat Pump, Combustion, Industrial Environment, Solar Energy Utilization, Weather Data, Physiological Research, Evaporative Cooling, Heating and Air Conditioning Loads, Insulation, Odors, and Sound and Vibration Control.

A conference was also held on Tuesday evening for the benefit of the editors of chapter publications. It attracted attendance from a considerable fraction of these editors. Its purpose is to serve as a meeting place where their particular problems can be discussed.

The Council of the Society met on Sunday preceding the Meeting and the organization of the 1958 Council took place at a meeting held on Thursday immediately after the close of the Meeting.

Some of the reproductions on the preceding pages are by courtesy of W. M. Wallace, II, Durham, N.C.

ACTIVITIES OF SOCIETY CHAPTERS

A variety of general technical talks were heard at local meetings of many chapters during the first part of the year. They included such subjects as: year-round air conditioning, solar heating installations, safety factors, industrial ventilation, missiles, air distribution and noise, controls, testing, economies and design.

Technical Talks

Members of the ARIZONA Chapter recently heard an informative talk on *Economics of Year-Round Air Conditioning*. The speaker was J. F. Comminsky, market manager, Commercial Division, Minneapolis-Honeywell Regulator Co., Minneapolis, Minn. • • • A talk on *Safety Control for Low Pressure Boilers* was heard by members of the ARKANSAS Chapter. The speaker was Bill Gleeson, McDonnell & Miller, Inc., Chicago, Ill. Mr. Gleeson explained the basic functions of safety controls for steam and water boilers and pointed out the progress that had been made in recent years in *ASME* Codes on relief valves for boilers and pressure vessels. Mr. Gleeson also emphasized the problems in having relief valves handle steam as compared to water. A lively question and answer period followed. • • • A panel discussion on commercial and industrial installations was the feature of a meeting of ATLANTA Chapter. The moderator was R. W. Wages, assistant manager, industrial power department, Georgia Power Co., and panel members, all from the Georgia Power Co., were H. T. Yopp, commercial sales engineer specialist, *Electric Service for Commercial Installations;* W. L. Westbrook, superintendent, Atlanta Division, *Operating Practices and Procedures for Furnishing Electric Service,* and C. W. Hamilton, industrial sales engineer, Atlanta Division, *Electric Service for Industrial Installations.* Each member of the panel made a short talk on matters pertaining to his department and an interesting question period followed. • • • The speaker at a meeting of BATON ROUGE Chapter was M. L. Hoaglund, manager, centrifugal refrigeration department, The Trane Co., La Crosse, Wis. Mr. Hoaglund explained the use of hermetically sealed centrifugal refrigerating machines in heat pump installations and said that with this type

K. E. Robinson, Detroit, Mich., Speaker at Connecticut Chapter Meeting

of machine, water is the only heat source that can be used economically. • • • A dramatic and enlightening talk on *Man-made Satellites and Their Relation with Outer Space* was heard by members of BLUEGRASS Chapter. The speaker was W. L. Moore, professor, mathematics department, University of Louisville, Louisville, Ky. • • • At a meeting of CONNECTICUT Chapter, K. E. Robinson, ventilation engineer on the research staff of General Motors Corp., Detroit, Mich., gave a talk on *Industrial Ventilation.* A special guest was A. J. Hess, 1st vice president of the Society, who gave a brief talk on the proposed merger of ASHAE-*ASRE.* • • • DELTA Chapter members heard an informative talk on the heat pump by M. L. Hoaglund, manager, centrifugal refrigeration department, The Trane Co., La Crosse, Wis. The group also heard C. B. Gamble, former member of Council and former regional director of Region 5, give a report on the proposed merger of ASHAE-*ASRE.* • • • An extremely interesting story of medium pressure air distribution with special emphasis on noise criteria was given before members of the EMPIRE STATE CAPITAL Chapter. The speaker was W. L. Batchelor, chief engineer, Tuttle & Bailey, division of Allied Thermal Corp., New Britain, Conn. • • • The application of hot water heating was covered in a talk before members of ILLINOIS Chapter by T. R. Stevens, vice president, Sarcotherm Controls, New York, N.Y. In his talk, illustrated by slides, Mr. Stevens explained the 2-pipe reverse return and the 2-pipe direct return and the 1-pipe hot water heating systems. Mr. Stevens commented that hot water lends itself to application of rambling installation, such as large apartment projects. The talk also covered the application of hot water heating in multi-story buildings and the use of hot water heating in process work, such as fur finishing and waxing of paper. • • • A highly informative talk on *Economic Advantages of Complete Year-Round Air Conditioning* was heard recently by IOWA Chapter members. The speaker, J. H. Jester, sales manager, Commercial Division, Minneapolis-Honeywell Regulator Co., Minneapolis, Minn., elaborated on the definition of air conditioning and said the factors affecting the economic advantages of air conditioning were the human efficiency increase which could be realized, reduced turnover, the ability to retain better personnel, increased comfort for customers and in certain instances, the reduction of cleaning bills and the preservation of merchandise. He compared the cost of complete air conditioning with the total cost of doing business and said the figures clearly indicated that complete year-round air conditioning is economical and could be expected to pay for itself easily. • • • R. S. Doherty, sales executive, National-U.S. Radiator Corp., Johnstown, Pa., recently addressed the JOHNSTOWN Chapter on *Better Heating and Cooling of Small Homes.* Hydronic heating and cooling systems and equipment were illustrated and the relative merits discussed. • • • L. E. Jennings, Jr., air conditioning product manager, Dunham-Bush, Inc., West Hartford, Conn., discussed *Remote Air Cooled Condensers* before members of LONG ISLAND Chapter. Earlier, F. H. Faust, regional director of Region 1, briefly discussed the proposed merger of ASHAE-*ASRE.* • • • Members of MICHIGAN Chapter heard an interesting talk on *High Temperature Hot Water* by Perry Ziel, P. H. Ziel-J. S.

Blossom & Assocs., Cincinnati, Ohio. Mr. Ziel outlined the history of high-temperature hot water and explained the thermodynamics of hot water, comparing steam and hot water systems. He explained the various systems used in pressurizing high-temperature hot water systems. A spirited question and answer period followed. • • • F. W. Hill, assistant superintendent of schools, who is in charge of business affairs of the Minneapolis public schools, addressed the MINNESOTA Chapter on the engineer's responsibility in school planning. • • • Subject of a talk before members of MISSISSIPPI Chapter was *Fan Testing at Texas A & M*, by Marlon Vernon of Doherty-Silentaire, Baton Rouge, La. • • • An enlightening talk by W. S. Morrison, vice president, Illinois Water Treatment Co., Rockford, Ill., on *Water Treatment* was well received by members of NEW MEXICO Chapter. • • • NEW YORK Chapter hailed a presentation given by W. L. Batchelor, chief engineer, Tuttle & Bailey, division of Allied Thermal Corp., New Britain, Conn., as one of the finest talks it has heard. In his talk, *Noise Control Analysis of Air Distribution Systems*, Mr. Bailey explained the fundamentals of sound, the means of measuring sound and the new criteria for designing quiet air-conditioning systems. • • • A most interesting presentation on *Air Source Heat Pumps* was given recently before members of NORTH JERSEY Chapter by R. L. Sanders, engineer, Industrial Division, York Corp., New York, N.Y. Mr. Sanders gave a general outline of the system design and discussed several typical installations. A lengthy question period followed. • • • An educational film, *Building for Tomorrow*, recently was shown to members of OREGON Chapter by speaker Bill Welch, vice president, Timber Structures, Portland, Ore. Mr. Welch pointed out that wood structures were the oldest structures used while glued laminated beams have been in existence for only about 30 years. He said that laminated beams have become the strongest material in common use per weight basis because of the extreme amount of flexibility, workability and eye appeal, as well as for their functional advantages for industry and in commercial buildings. Following the meeting, members made a tour of Timber Structures manufacturing facilities. • • • Clifford Thompson, Honeywell Controls, Toronto, Ont., Can., gave an illustrated talk on *Economics of Year-Round Air Conditioning* at a recent meeting of ONTARIO Chapter. A discussion period followed. Members of the University of Toronto Student Branch were guests at the meeting. • • • An excellent talk on *The Petroleum Industry and the Economics of Oil Heat* was given by Robert Elmslie, managing director of the *Oil Heat Institute*, before members of the PUGET SOUND Chapter. • • • One of the most thought-provoking talks ever to be heard at a chapter meeting was reported by ROCKY MOUNTAIN Chapter recently. The subject, *The Impact of Electronic Computers on Today's Life and Tomorrow's*, was presented by Stan Farwell, data processing sales representative, International Business Machines Co., Denver, Colo. At another Rocky Mountain Chapter meeting, members heard a talk by Otto Hall, chief engineer, Public Works Section of the State of Colorado, regarding the program of construction and remodeling of state-owned structures. • • • A very interesting talk on *Control of Low-Pressure and High-Pressure Air-Conditioning Systems* was given before members of ST. LOUIS Chapter recently by J. H. Colby, Johnson Service Co., Milwaukee, Wis. • • • Problems on *Collecting and Storing of Solar Heat* were discussed by H. E. Voegeli, development engineer, American Brass Co., Waterbury, Conn., at a meeting of SOUTH TEXAS Chapter. • • • A most informative talk on *Vibration, Shock and Noise Control for Air Conditioning* was heard by SOUTHERN CALIFORNIA Chapter members recently. The speaker was Jack Harris, chief engineer, The Korfund Co., Inc., Long Island City, N.Y. A question and answer period followed the illustrated subject. Jack Miller of the Student Activities Committee announced his program to assist students in securing employment within the industry. Mr. Miller and E. B. Hilton will handle the student summer employment program. M. G. Lowe will coordinate lectures and field trips for student groups. • • • The history of fire and venting practices was outlined in a talk on *Fire Prevention* by G. W. Fulbright, fire marshall, San Antonio, Tex., at a meeting of SOUTHWEST TEXAS Chapter. Mr. Fulbright showed slides of defective venting installations which led to fires. He also discussed the new city code concerning the requirements for grease filters in range hoods. Mr. Fulbright also touched briefly on the needs and requirements for a good Civil Defense Program. • • • An interesting and informative lecture on *High-Velocity Duct Design* was illustrated by W. F. Peters, assistant general sales manager, Anemostat Corporation of America, New York, N.Y. The talk was given before members of the UTAH Chapter, many of whom remained after the meeting had adjourned to discuss various features of Mr. Peter's talk. • • • An elaborate work model was used to demonstrate a typical double-duct control system before WEST TEXAS Chapter. J. H. Traynor, branch manager, Johnson Service Co., Kansas City, Mo., was the speaker. A discussion period followed. • • • B. H. Jennings, director of research, ASHAE Research Laboratory, Cleveland, Ohio, gave an interesting talk before WESTERN MICHIGAN Chapter on research in general and the research program that ASHAE is maintaining. Professor Jennings commented that research appears to move slowly, but that its end results have proven its importance. • • • Joel Isenberg, chief, Aerophysics

FIRST LIFE MEMBERS' AWARD TO LINN HELANDER

Linn Helander *(right)*, Manhattan, Kan., receives an Award of Merit, the first of its kind, from E. K. Campbell, former treasurer of ASHAE, in his capacity as secretary of the Life Members (ASHAE) Club. The award, presented at a recent Kansas City Chapter meeting, is in recognition of Professor Helander's outstanding service and achievement in teaching

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F. X. Loeffler, Sr., receives his Life Membership Certificate from W. J. Collins, Jr., chairman of the Publicity Committee, Oklahoma Chapter. Mr. Loeffler was also presented with a gold Life Membership card

Special Weapons Division, Bell Aircraft, Niagara Falls, N.Y., discussed *The Missile and Satellites* at a meeting of WESTERN NEW YORK Chapter. A 30-min question period followed Dr. Isenberg's interesting talk.

Other Chapter Activities

Many wives of members of KANSAS CITY Chapter attended the chapter's recent *Ladies' Night*. The feature of the affair was the presentation of the Life Members Club award to Linn Helander for outstanding work relative to the air-conditioning industry in the field of education. Hugh O'Dower showed the group an interesting film of his trip around the world. • • • Members of DELTA Chapter enjoyed a dinner dance following a recent chapter meeting.

CANDIDATES FOR MEMBERSHIP

Listed here are the names of 106 men who are the candidates for membership or advancement in membership grade. Members are requested to assume their full share of responsibility of receiving these candidates into membership by advising the Executive Secretary before April 30, 1958, of any whose eligibility for membership is questioned. Unless such objection is made these candidates will be voted upon by the Council.

Note: **Advancement* †*Reinstatement*

Alabama (*Region* 5)

POTTER, P. J., Head Prof., Dept. of Mech. Engrg., Alabama Polytechnic Inst., Auburn.

California (*Region* 4)

BRADLEY, P. T., Plumbing and Heating Contractor, San Francisco.
EAGLESON, H. W., Owner, Eagleson Engineers, San Francisco.
MCALONEY, H. G., Jr., Sales Engr., W. H. Steele Co., Los Angeles.

Colorado (*Region* 3)

CONTI, P. T., Tech., Johnson Service Co., Denver.

Connecticut (*Region* 1)

CONNELL, R. B., Mgr., A-C. Sales, Flexible Tubing Corp., Guilford.
KOTON, JACOB, Chief Engr., Raymond I. Miller Assocs., Hartford.

District of Columbia (*Region* 5)

CANNON, H. E., Pres., Cannon Engineering Co., Washington.

Florida (*Region* 5)

BONEY, PAISLEY, III, Sales Engr., A-C. Div., Westinghouse Electric Corp., Jacksonville.
CHENEY, J. G. JR., Mech. Designer, Kenneth G. Cooper & Assocs., Orlando.
LEMLEY, R. M., Assoc., Frank B. Wilder & Assocs., Jacksonville.
LINDBALD, J. E., Engr. Henley & Beckwith, Inc. Jacksonville.

Illinois (*Region* 2)

COOPER, D. L., Designer, Illinois Central Railroad, Chicago.
GILKERSON, A. R., Mech. Design Engr., Beling Engineering Consultants, Peoria.
JOHNSON, D. G.*, Sales Engr., Russell J. Smith, Inc., Peoria.
KLEINSCHMIDT, C. L., Sales Engr., York Corp., Chicago.
LAUNSPACH, V. F.*, Sales Engr., Chicago Blower Corp., Chicago.
MCQUOWN, F. G., Sales Mgr., American Foundry & Furnace Co., Bloomington.
MONTGOMERY, D. R., Part Owner, Lee Wagener Co., Peoria.
PETERSON, P. A., Secy., J. P. Baldwin Co., Chicago.
SCHWARZ, FRED., Engr., Naess & Murphy, Chicago.
SCHMIDT, R. D., Draftsman, Associated Engineers, Peoria.

Indiana (*Region* 2)

DWYER, J. C., Sales Engr., Powers Regulator Co., Gary.
MILLER, H. F., Sales Engr., Weil-McLain Co., Michigan City.
PUGH, H. M.*, Chief Engr., Thermo-Products, Inc., North Judson.
STANFORD, C. L., Pres., Electriliving Corp., Indianapolis.

Iowa (*Region* 3)

GOOD, D. L., Appl. Engr., Lennox Industries, Inc., Des Moines.
MILLER, C. W., Mfrs. Repr., Des Moines.
SCHAFFER, J. M., Prod. Design Engr., Waterloo Register Co., Inc., Waterloo.

(*continued on p.* 169)

TECHNICAL ADVISORY COMMITTEE EVENTS

At the Pittsburgh Meeting, a number of the TA Committees met, conferred, planned and acted on many subjects among which the following ones are of general interest.

Air Cleaning: discussed standardization of test equipment, necessity for its standardization, together with possible sources of supply, made no recommendations; reviewed manuscript of a paper for Society presentation; went over a progress report and plans for the air cleaner project at the University of Minnesota; discussed plans for preparation of a standard for testing air cleaners.

Combustion: Battelle staff requested to prepare a report covering the flame pulsation project for AGA Research and Utilization Conference being held this month; recommended that Research Laboratory review literature and prepare paper on the *Ventilation Requirements for Fuel-Burning Equipment.*

Heating & Air Conditioning Loads: accepted reports of 2 of its sub-committees, one on AC Load and one on Infiltration; authorized literature search and research proposal on load reduction due to hoods and on establishing pressure differentials at various levels in buildings.

Heat Pump: reviewed material prepared by committee members for use in new heat pump chapter in 1959 HVAC GUIDE. *Hot Water & Steam Heating*: suggested that its name be changed to TAC on Hydronic Heating & Cooling, and that its scope be extended; recommended that the Research Laboratory prepare a steam weight-flow table (pressures of 3.5 to 12 psig) for range 1 to 15 psig and charts for higher pressures, for possible use in HVAC GUIDE.

Sorption: heard reports on the progress of the research projects at the University of Toledo and The Pennsylvania State University; made plans to revise material in sorption chapter in HVAC GUIDE; was told that its Standard for Testing is in hands of Standards Committee.

BITUMINOUS COAL BULLETINS

As a result of its research program, Bituminous Coal Research, Inc., has recently made available 2 bulletins. One of these is entitled *Flow of Coal in Bins* while the other one carries the title *Problems in the Development of the BCR Automatic Coal-Fired Packaged Steam Generator.* Both these bulletins are available from Bituminious Coal Research, Inc. with a nominal charge.

(*Continued from p. 168*)

Kansas (*Region* 3)

JOHNSON, G. W., Design Engr., Moore & Clark, Topeka.

Louisiana (*Region* 5)

MILLS, W. C., Br. Mgr., York Corp., New Orleans.

THOMPSON, E. C., Div. Mgr., Empire Southern Gas Co., Minden.

Maryland (*Region* 5)

ROBERTS, W. D., Htg.-Cooling Repr., American Radiator & Standard Sanitary Corp., Baltimore.

Massachusetts (*Region* 1)

SPOHR, C. D., Sr. Engr., Francis Associates, Marion.

Michigan (*Region* 2)

IRWIN, J. F., Gen. Mgr., Air Filter Sales & Service Co., Inc., Hazel Park.

Minnesota (*Region* 3)

MCLOUTH, M. E., Chief Air Pollution Engr., City of Minneapolis.

WILCKEN, C. A., Jr., Mech. Engr., Ellerbe & Co., St. Paul.

Nebraska (*Region* 3)

FRY, D. E., Engr., Natkin & Co., Omaha.

New Jersey (*Region* 1)

WAHL, H. L., Repr., Sarco Co., Inc., Newark.

New Mexico (*Region* 6)

WARD, R. R., Area Engr., University of California, Los Alamos.

New York (*Region* 1)

ELISCU, LAURENCE, Sales Engr., James W. McGuire Co., New York.

ERIKSEN, W. R.†, Chief Mech. Engr., George A. Fuller Co., New York.

FASSLER, E. A., Design Engr., Sargent, Webster, Crenshaw & Folley, Syracuse.

FILEY, C. A., Sales Engr., James W. McGuire Co., New York.

KABACK, S. C., Pres., Weathermatic Corp., Long Island City.

LEVINE, MILTON, Vice Pres., Standard Refrigerators, Inc., New York.

LIPSTEIN, N. J., Air Handling Engr., General Engrg. Laboratory, General Electric Co., Schenectady.

MARKS, R. L., Vice Pres., Nassau Div., Sunrise Oil Co., Inc., Mineola.

MICHAELI, DAVID, Engr., Cosentini Associates, New York.

MIRABELLA, T. A., Engr., Race City Corp., Valley Stream.

ORTOLEVA, C. J., Chief Designer, City Sheet Metal Air Conditioning Corp., Valley Stream.

PILLET, F. J., Engr., Minneapolis-Honeywell Regulator Co., Long Island City.

ROTEM, E. J., Appl. Engr., Westinghouse International, New York.

ROWE, S. B., Jr., Sales Engr., Buffalo Forge Co., New York.

WINSTON, A. D.*, Engr., James H. Martin Inc., New York.

Ohio (*Region* 2)

GERDSEN, A. H.*, Pres., The A. H. Gerdsen Co., Cincinnati.

HUGHES, R. R., Jr., Sales Engr., Minneapolis-Honeywell Regulator Co., Cincinnati.

KESSEN, C. F.*, Asst. to Pres., Mutual Manufacturing & Supply Co., Cincinnati.

MORRIS, J. E., Br. Mgr., Richard Equipment Co., Dayton.

WILSON, F. W.*, Engr., R. E. Kramig Co., Inc., Cincinnati.

Oklahoma (*Region* 6)

FREEBURG, W. M., Sales Engr., Loeffler-Greene Supply Co., Tulsa.

MULLINS, G. D., A-C. Engr., Loeffler-Greene Supply Co., Tulsa.

Pennsylvania (*Region* 1)

BRANDON, F. W., Engrg. Mgr., Limbach Co., Pittsburgh.

GEARY, J. C., Dvlpt. Engr., National-U. S. Radiator Corp., Johnstown.

KUPETZ, F. G.†, Engr., Partner, Kupetz Bros., Barnesboro.

MCKEE, J. J., Purchasing Agent, Limbach Co., Pittsburgh.

OLSEN, H. M.†, In Charge of Htg.-Vtg. Dept., Pierce Phelps Corp., Philadelphia.

Tennessee (*Region* 5)

SMITH, J. W., Repr., Minneapolis-Honeywell Regulator Co., Memphis.

SPANN, D. E., Mech. Engr., Tennessee Eastman Co., Kingsport.

Texas (*Region* 6)

DILLARD, G. H., Owner, G. H. Dillard Co., San Antonio.

JESSUP, T. J., Jr., Draftsman, Farwell-Wallace Joint Venturers, Dallas.

LAYTON, R. E., Jr.*, Partner & Chief Engr., Layton Engineering Co., Tyler.

LESTER, S. P., Sales Engr., Fluor Products Co., Dallas.

MARSH, R. E., Jr., Sales Engr., Powers Regulator Co., Houston.

MITCHELL, EDGAR, Foreman, Fort Bliss Center Engineer Heat Shop, Fort Bliss.

SMITH, T. W., Sales Engr., Buffalo Forge Co., Houston.

Utah (*Region* 4)

WARREN, C. E., Sales Engr., The Trane Co., Salt Lake City.

Washington (*Region* 4)

BAKER, A. H., Br. Mgr., Refrigerative Supply, Inc., Spokane.

BLOCHER, MELVIN, Estimating Engr., Royal Co., Inc., Kennewick.

KNAPP, W. C., Owner, Knapp & Co., Spokane.

PATRICK, R. L., Repr., Crane Co., Spokane.

Wisconsin (*Region* 2)

BUSCH, C. J., Engrg. Trainee, Barber-Colman Co., Milwaukee.

HOMBSCH, R. C., Engr., Holland & Beseke, Milwaukee.

Canada (*Region* 7)

BARRAN, A. R., Vice Pres., Moore & Barran Ltd., Toronto, Ont.

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BATES, G. H., Sales Engr., Foster Wheeler, Ltd., Toronto, Ont.

BRINK, THEODORE, Sales Mgr., A. I. Distributors, Ltd., Edmonton, Alta.

CHESNEY, D. S., Secy.-Treas., G. L. Chesney Hardware, Ltd., Calgary.

CHISHOLM, R. R., Repr., Demers & Chisholm Sheet Metal, Ltd., Calgary, Alta.

CURRIE, G. H., Head, Mech. Engrg. Dept., Smith Carter Katelnikoff, Winnipeg, Man.

DE GUISE, PIERRE, Cons. Engr., Montreal, Que.

FOWLER, R. S., Repr., Dunham-Bush (Canada) Ltd., Edmonton, Alta.

HEARNDEN, G. A., Control Engr., Canadian Comstock Co., Ltd., Ottawa, Ont.

JAMES, H. M., Br. Mgr., Ross Engineering of Canada, Ltd., Fredericton, N. B.

JEFFS, G. A., Proprietor, Alpha Engineering Co., Toronto, Ont.

MADIGAN, B. C., Repr., Trane Co. of Canada, Ltd., Toronto, Ont.

MARTIN, LEONARD†, Pres., Martin Engineering, Inc., Montreal, Que.

MCCALLUM, A. W., Estimator, Haddow and Maughan, Ltd., Edmonton, Alta.

MOORE, SAMUEL, Pres., Moore-Barrow Ltd., Toronto, Ont.

MITCHELL, K. W., Mgr., Customer Service, Canadian Western Natural Gas Co., Calgary, Alta.

RACINE, JEAN, Repr., Warden King Ltd., Montreal, Que.

SCOUTEN, R. E., A-C. Designer, H. H. Angus & Assocs., Toronto, Ont.

SMITH, B. O., Pres., Baxter Smith Plumbing & Heating Ltd., Toronto, Ont.

WHEELER, D. R., Chief Engr. for Western Canada, Lennox Industries (Canada) Ltd., Calgary, Alta.

Ireland

CIONNAOITH, E. O., Sr. Partner, J. A. Kenny & Partners, Dublin.

Italy

MAZZINI, LUIGI, Co-Owner, Mazzini & Griffini Co., Milan.

Pakistan

KHAN, H. R., Exec. Engr., Pakistan Public Works, Government of Pakistan, Karachi.

OBITUARIES

EDWARD E. ASHLEY, JR.
New York, N.Y.

Edward E. Ashley, Jr., senior partner, Edward E. Ashley, Consulting Engineers, New York, N. Y., died at his home in Noroton Heights, Conn., on February 3 at the age of 74. A Life Member of the Society, he began his affiliation in 1912.

Mr. Ashley gained national recognition in the air-conditioning and illumination engineering fields, as well as for his work on electric elevators. He was responsible for the development of a special glass for use in department stores to diffuse the lighting and improve the appearance of merchandise displays.

Educated in the public school system of New York, N. Y., his birthplace, Mr. Ashley also took advanced engineering training at Cooper Union and Cornell University. He gained his early experience with Thompson Starrett Co., W. G. Cornell Co. and Starrett & Van Vleck, New York, N. Y.

During World War I, Mr. Ashley served as chief of the Motor Transport Branch in the Air Service, U. S. Army. After retirement from service, he was connected for a short time with the Mercury Manufacturing Co., Chicago. He later transferred to New York and was a consulting, mechanical and electrical engineer for Starrett & Van Vleck before he established his own firm in 1932. The firm maintains offices in Washington, D. C., and Amsterdam, The Netherlands, as well as in New York.

Mr. Ashley was selected to serve as Society representative on the *ASA* Sectional Committee on Standardization of a Scheme for Identification of Piping Systems. In addition to ASHAE, he held membership in numerous organizations:

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ASME, AIEE, Illuminating Engineering Society, New York Association of Consulting Engineers, New York Society of Professional Engineers, Society of American Military Engineers, National Geographic Society, the Union League Club of New York, and many others. For a number of years he had been chairman of the Darien Water and Sewer Commission.

Surviving are his wife, Beulah Watson Ashley; two sons, Edward E., III, Arlington, Va., and Austin S., Sudbury, Mass.; a sister, Mrs. Edna Bayne, Downer's Grove, Ill., and two brothers, George, New York, and James, Scarsdale, N. Y.

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ROBERT K. THULMAN
Washington, D.C.

Robert K. Thulman, 59, who had been associated with the Chimney Sales Corp., Washington, D.C., for the last few years, died on February 21. Previous to this recent connection, Mr. Thulman had served for almost twenty years as mechanical engineer in the Technical Division, National Housing Agency, Federal Housing Administration, Washington.

An active member of the Society since he joined in 1938, Mr. Thulman served on numerous Society committees, including the Joint Committee on Standards for Residence Heating, and the Technical Advisory Committees on Heat Requirements of Buildings, on Fuels, on Heating Load, on Insulation, and on Combustion. He also served on the Committee on Research, and was a contributor to THE GUIDE. Mr. Thulman was co-author with L. E. Seeley of a paper on Heating Low-Cost Homes, which was published in the TRANSACTIONS of the Society. Several articles on heating which were written by Mr. Thulman appeared in various other technical publications.

Mr. Thulman, who was born in Arlington, N. J., attended Stuyvesant High School, New York, N.Y. He received his B.S. in engineering administration from Massachusetts Institute of Technology in 1922.

Early in his career he joined the Socony Burner Corp., New York, N.Y., acting first in the capacity of service manager, and later as research engineer. In 1927, he joined the International Boiler Works Co., East Stroudsburg, Pa. He entered government service in 1935 as a heating engineer with the Resettlement Administration, transferring to the Federal Housing Administration two years later.

Mr. Thulman reviewed heating plans and specifications for large-scale housing projects. He also was engaged in the formulation of standards for residence heating.

He is survived by his wife, who resides at their home in Silver Spring, Md.

EARL L. HILBURG
Los Angeles, Calif.

Earl L. Hilburg, 63, died on February 2. He made his home in Los Angeles, Calif. Mr. Hilburg was a member of the Southern California Chapter of the Society.

Born in Galva, Ill., Mr. Hilburg later moved to California where he was a partner in the engineering firm of Hilburg, Hengstler, & Turpin, Los Angeles.

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LEONARD W. BONKEMEYER
Greensboro, N.C.

Leonard W. Bonkemeyer, 45, newly elected member of the Society, died recently. Mr. Bonkemeyer had been a representative for the Crane Co., Greensboro, N. C., since 1941.

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SAMUEL E. LYMAN
New York, N.Y.

Samuel E. Lyman, 68, died on February 12 after a brief illness. Mr. Lyman joined the Society in 1924 and was granted Life Membership in 1954.

A member of the research staff of Buensod-Stacey, Inc., New York, N. Y., Mr. Lyman was an authority on the development of automatic controls for air conditioning and was one of the group of engineers and executives who founded Buensod-Stacey more than twenty years ago.

He is survived by his widow.

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CYRIL D. SEYMOUR
Willowdale, Ont.

Cyril D. Seymour, 64, passed away recently. He was a member of the Ontario Chapter of the Society.

Mr. Seymour worked his way up to the presidency of Seymour Plumbing & Heating Contractors, Ltd., Willowdale, Ont., which he had been with for 49 years.

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ERNEST H. NORTON
Seattle, Wash.

Ernest H. Norton, 77, of the Puget Sound Chapter, died on February 22 in a nursing home. He was a member of the Society since 1946.

Born in Clarksville, Mo., Mr. Norton moved to Seattle in 1900 where he was a manufacturer's representative for Sarco Co., Inc., New York, N.Y., and Fitzgibbons Boiler Co., New York, N.Y., and later opened his own business.

Mr. Norton was a veteran of the Spanish-American War and a member of Fortson-Thygesen Camp No. 2, United Spanish War Veterans. From 1908 to 1910 he was a captain in the National Guard. Mr. Norton was also a life member of Seattle Lodge No. 92, Elks, and a member of Rainier Council, Royal Arcanum.

Surviving are a son, William N.; a daughter, Mrs. Irene Wascher; a sister, Grace; all of Seattle, and three grandchildren.

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HAROLD A. THORNBURG
New York, N. Y.

Harold A. Thornburg, 54, Society member since 1929, died on March 1, in Holy Name Hospital, Teaneck, N. J.

Mr. Thornburg, formerly in charge of air conditioning and ventilation for U. S. Rubber Co., New York, N.Y., was appointed in 1952 as assistant manager of industrial engineering for that company. He assumed the position of manager a few years later. Born in Paducah, Ky., he was graduated from the University of Kentucky in 1929 with a B.S. in mechanical engineering.

Surviving are his wife, Annette K.; a daughter, Joan Anne; a son, Harold A., Jr.; his mother, Mrs. Shelley Thornburg; a brother, William H. of California, and a sister, Mary.

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DICK W. WHITTINGTON
Indianapolis, Ind.

An Indiana Chapter member, Dick W. Whittington, 46, president, Whittington Pump & Engineering Corp., Indianapolis, Ind., died in Community Hospital on January 4th. He had been a member of the Society for the past nine years.

Mr. Whittington was born in Mount Vernon, Ohio. After studying electrical engineering at Purdue University, he first joined his father at W. P. Whittington & Co. in 1932. He remained with his father's company, later known as Whittington Pump & Engineering Co., except for intervals in equipment testing for P. R. Mallory & Co., Inc., Indianapolis, and in plant engineering with International Harvester Co., Chicago. He became chief engineer of the Whittington firm in 1944, then successively vice president in charge of engineering and vice president in charge of sales. In 1948, he assumed the presidency.

He was a member of Irvington Methodist Church, Rotary Club, Scientech Club and the executive board of Central Indiana Council, Boy Scouts of America. Mr. Whittington was the first president of Marion County Little League, Inc., and was a charter member of the Indianapolis Symphonic Choir.

Surviving are his widow, Mildred; a daughter, Mary Lynn; a son, David P., and his mother, Mrs. Enid C. Whittington, all of Indianapolis.

Presidents and Secretaries of Society Chapters and Branches

The Society has chartered 72 Chapters, 1 Overseas Branch, and 6 Student Branches. These organizations elect their own officers and governing boards. Following is a list giving the name and address of the president and secretary of each of these groups.

Date indicates year organized; and address and no city shown signifies same city as headquarters; numeral in parentheses indicates zone.

ARIZONA

Arizona: 1953. Hdqrs., Phoenix. Meets, 1st Mon. PRES, E. P. Boothroyd, 1341 W. Catalina Dr. SECY, G. L. Jackson, Jr., 932 E. San Miguel.

ARKANSAS

Arkansas: 1952. Hdqrs., Little Rock. Meets, 3rd Tues. PRES, H. H. Himstedt, 510 E. 3rd St. SECY, Allen Bullard, 509 E. Markham St.

CALIFORNIA

Golden Gate: 1937. Hdqrs., San Francisco. Meets, 1st Thurs. PRES, Herb Duncan, 938 N. Linden Ave., South San Francisco. SECY, T. R. Simonson, 507 Howard St. (5).

Sacramento Valley: 1952. Hdqrs., Sacramento. Meets, 1st Wed. PRES, M. J. Delavan, 405 Meister Way (19). SECY, R. T. Andrews, 4305 Laurelwood Way (21).

Southern California: 1930. Hdqrs., Los Angeles. Meets, 1st Tues. PRES, W. J. Biggar 6620 Telegraph Rd. (22). SECY, R. C. Taylor, 1270 Tropical Ave., Pasadena (8).

COLORADO

Rocky Mountain: 1944. Hdqrs., Denver. Meets, 1st Wed. PRES, D. D. Pearsall, 120 W. 5th Ave. SECY, J. F. Perkis, 3453 S. Forest St. (22).

CONNECTICUT

Connecticut: 1940. Hdqrs., New Haven. Meets, 3rd Thurs. PRES, Fritz Honerkamp, 36 E. Maxwell Dr., West Hartford (7). SECY, F. J. Raible, Jr., 1007 Farmington Ave., West Hartford (7).

DISTRICT OF COLUMBIA

Washington, D.C.: 1935. Hdqrs. Washington, D.C. Meets, 2nd Wed. PRES, H. W. Rush, 116 Southwood Ave., Silver Spring, Md. SECY, L. D. Pain, 102-B Ames Rd., Silver Spring, Md.

FLORIDA

Jacksonville: 1957. Hdqrs., Jacksonville. Meets, 1st Tues. PRES, B. J. Saymon, P.O Box 4817 (1). SECY, G. A. Israel, Jr., 115 Park St., P.O. Box 2527 (3).

GEORGIA

Atlanta: 1937. Hdqrs., Atlanta. Meets, 2nd Mon. PRES, J. A. Marshall, 1415 Howell Mill Rd. SECY, W. P. West, 409 Bishop St., N.W. (13).

Savannah: 1958. Hdqrs., Savannah. PRES, R. L. Reiley, 113 Harlan Dr. SECY, R. E. Kinser, Box 3368, Station A.

ILLINOIS

Illinois: 1906. Hdqrs., Chicago. Meets, 2nd Mon. PRES, H. E. Anderson, 530-544 Hyde Park Ave., Hillside. SECY, J. C. Scott, 6655 N. Ridge Blvd. (26).

Illinois-Iowa: 1956. Hdqrs., Moline. Meets, 3rd Mon. PRES, W. W. Dodge, 3125 N. Sheridan Rd., Peoria. SECY, E. O. Hull, 1009 Ridge Rd., Peoria.

INDIANA

Indiana: 1943. Hdqrs., Indianapolis. Meets, 4th Tues. PRES, G. W. Vogel, 31 E. Georgia St. (4). SECY, J. M. Teskoski, 111 E. 34th St.

IOWA

Iowa: 1940. Hdqrs., Des Moines. Meets, 2nd Tues. PRES, W. A. Schworm, Physical Plant Dept., Iowa State College, Ames. SECY, C. B. Campbell, 3121 Dean Ave.

KANSAS

Kansas: 1951. Hdqrs., Wichita. Meets, Tues. after 1st Mon. PRES, T. L. Roberts, 2008 S. Parkwood (18). SECY, G. L. Oswald, 1117 E. Waterman.

KENTUCKY

Bluegrass: 1954. Hdqrs., Louisville. Meets, 2nd Mon. PRES, O. J. Hill, 319 W. Jefferson St., Rm. 316 (2). SECY, H. L. Carr, 2725 Shannon Dr. (5).

LOUISIANA

Baton Rouge: 1955. Hdqrs., Baton Rouge. Meets, 3rd Wed. PRES, A. W. Holland, 3958 Convention St. SECY, J. P. Jones, Box 358.

Delta: 1939. Hdqrs., New Orleans. Meets, 3rd Tues. PRES, L. R. Maxwell, 3038 Earhart Blvd. (25). SECY, J. H. Maloney, 501 N. Jefferson Davis Pkwy. (19).

Shreveport: 1948. Hdqrs., Shreveport. Meets, 3rd Thurs. PRES, A. J. Jones, Jr., 753 Gladstone. SECY, J. L. Collins, Jr., 640 Delaware St.

MARYLAND

Baltimore: 1949. Hdqrs., Baltimore. Meets, 3rd Wed. PRES, R. E. Dressell, c/o F. M. Hewitt, 33 E. 21st St. (18). SECY, J. H. Baker, 2 E. 22nd St. (18).

MASSACHUSETTS

Massachusetts: 1912. Hdqrs., Boston. Meets, 3rd Tues. PRES, E. L. Blair, 108 Willow Ave., Wollaston (70). SECY, R. E. Reid, 313 Washington St., Newton (58).

Western Massachusetts: 1955. Hdqrs., Springfield. PRES, F. A. Ferraro, 293 Bridge St. SECY, J. J. Curran, 207 Liberty St. (4).

Society Organization Personnel

Council and Council Committees, Advisory Board, General and Special Committees: The latest list of the Council and Council Committees, Advisory Board, and General Committees appears in the February 1958 JOURNAL SECTION on page 146

Nominating Committee: This committee's membership is fixed by the By-Laws. The latest listing appears in the February 1958 JOURNAL SECTION on page 146

Society Regional Organization: The 1958 listing of the names of the Regional Directors and of the members of the Chapters Regional Committees appears in the March 1958 JOURNAL SECTION on page 184

Research Committees: The research program is under the guidance of the Committee on Research — a General Committee. The Committee on Research appoints Technical Advisory Committees as needed. The 1958 personnel is scheduled to appear in the June 1958 JOURNAL SECTION. The 1957 listing appears in the December 1957 issue on page 160

Society Chapters and Branches: The Society has chartered 72 Chapters, 1 Overseas Branch, and 6 Student Branches. These groups elect their officers and governing boards. A list of the presidents and secretaries appears above and on the following page.

JOURNAL SECTION

MICHIGAN

Michigan: 1916. Hdqrs., Detroit. Meets, 1st Mon. after 10th of month. PRES, P. S. Hosman, 16141 Harlow Ave. (35). SECY, J. B. Olivieri, 9317 Gratiot (13).

Western Michigan: 1931. Hdqrs., Grand Rapids. Meets, 2nd Mon. PRES, B. J. Walter, 333 Fuller Ave., N.E. (3). SECY, S. R. Curtis, 1810 W. Rundle, Lansing.

MINNESOTA

Minnesota: 1918. Hdqrs., Minneapolis. Meets, 1st Mon. PRES, Fred Vogt, 6530 W. Lake St. (26). SECY, J. W. McNamara, 850 Cromwell Ave., St. Paul (14).

MISSISSIPPI

Mississippi: 1953. Hdqrs., Jackson. Meets, 4th Mon. PRES, T. D. Luke, P.O. Box 1134 413 S. President. SECY, M. E. Arledge, P.O. Box 2324.

MISSOURI

Kansas City: 1917. Hdqrs., Kansas City. Meets, 1st Mon. PRES, S. C. McCann, 210 W. 10th St. (5). SECY, L. A. Heaven, 1529 Wyandotte (8).

St. Louis: 1918. Hdqrs., St. Louis. Meets, 2nd Tues. PRES, N. J. Hubbuch, 7020 Cornell, University City (5). SECY, K. O. Williams, 3200 Oliver Ave., East St. Louis.

NEBRASKA

Nebraska: 1940. Hdqrs., Omaha. Meets, 2nd Tues. PRES, M. F. Stober, 633 Insurance Bldg. SECY, F. P. Manchester, Jr., 1141 S. 19th (3).

NEW JERSEY

North Jersey: 1952. Hdqrs., Newark. Meets, 2nd Tues. PRES, Martin Christesen, 21 Valley Brook Dr., Emerson. SECY, L. G. Huggins, 69 Woodland Ave., Glen Ridge.

NEW MEXICO

New Mexico: 1954. Hdqrs., Albuquerque. Meets, 3rd Tues. PRES, J. K. James, 4462 Avenida del Sol, N.E. SECY, R. P. Lee, 114 Granite Ave., N.W.

NEW YORK

Central New York: 1944. Hdqrs., Syracuse. Meets, 4th Wed. PRES, Merle Weninger, 230 Goodrich Ave. SECY, S. F. Gilman, 300 S. Geddes St. (1).

Empire State Capital: 1951. Hdqrs., Albany. Meets, 2nd Wed. PRES, H. F. Kruger, 501 Seventh Ave., Troy. SECY, B. E. Mullen, Maplewood & Kraft Aves.

Long Island: 1957. Hdqrs., Garden City. Meets, 2nd Mon. PRES, H. J. Campbell, Jr., 288 Old Country Rd., Mineola. SECY, J. L. Page, 41 W. 22nd St., Huntington Station.

New York: 1911. Hdqrs., New York. Meets, 3rd Mon. PRES, C. R. Hiers, 19 Westminster Rd., Great Neck. SECY, L. D. Carr, 534 West Broadway.

Western New York: 1919. Hdqrs., Buffalo. Meets, 2nd Mon. PRES, G. E. Kuhn, 475 Woodland Dr., Kenmore (23). SECY, D. J. Seifert, 220 Delaware Ave. (2).

NORTH CAROLINA

Northern Piedmont: 1952. Hdqrs., Greensboro. Meets, 2nd or 3rd. Fri. PRES, G. B. Rottman, 233½ N. Greene. SECY, E. A. Stroupe, Jr., P.O. Box 3135.

Southern Piedmont: 1952. Hdqrs., Charlotte. Meets, last Mon. PRES, G. C. Garrett, P.O. Box 3697 (3). SECY, N. W. McGuire, 1314 E. Fourth St.

OHIO

Central Ohio: 1944. Hdqrs., Columbus. Meets, 3rd Mon. PRES, T. R. Walker, 182 N. Yale Ave. SECY, J. W. Ford, 2—15th Ave.

Cincinnati: 1932. Hdqrs., Cincinnati. Meets, 1st Tues. PRES, T. D. Reiley, 1905 Dunlap St. (14). SECY, E. A. Sobolewski, 3207 Hardisty Ave. (8).

Miami Valley: 1950. Hdqrs., Dayton. Meets, 1st Wed. PRES, L. P. Brehm, 315 S. Bromfield Rd. (9). SECY, N. O. Mitchell, 1441 Milburn.

Northern Ohio: 1916. Hdqrs., Cleveland. Meets, 2nd Mon. PRES, R. E. Leising, 3250 Dellwood Rd., Cleveland Heights (18). SECY, J. F. Koran, 4318 Bucyrus Ave. (9).

Toledo: 1954. Hdqrs., Toledo. Meets, 1st Mon. PRES, Robert Greenwald, 2525 Portsmouth Ave. (13). SECY, G. R. Munger, 1254 Shelly Ave., Maumee.

OKLAHOMA

Northeastern Oklahoma: 1948. Hdqrs., Tulsa. Meets, 2nd Tues. PRES, C. H. Dollmeyer, 4972 E. 26th St. SECY, R. H. Combs, P.O. Box 871 (2).

Oklahoma: 1935. Hdqrs., Oklahoma City. Meets, 2nd Mon. PRES, A. C. Shelley, 2946 Nimitz (12). SECY, W. H. Stewart (Mail to: W. R. Johnson, 120 E. Main).

OREGON

Oregon: 1939. Hdqrs., Portland. Meets, Thurs. after 1st Tues. PRES, W. B. Hayes, 6446 N.E. 24 (11). SECY, W. S. Cooper, 445 Pittock Block.

PENNSYLVANIA

Johnstown: 1957. Hdqrs., Johnstown. PRES, W. L. Ross, 2051 Franklin St. SECY, J. K. Thornton, R.D. 4, Box 230.

Philadelphia: 1916. Hdqrs., Philadelphia, Meets, 2nd Thurs. PRES, P. H. Yeomans, 10 S. 18th St. (3). SECY, D. S. Plewes, 2853 N. 12th St. (33).

Pittsburgh: 1919. Hdqrs., Pittsburgh. Meets, 3rd Mon. PRES, E. H. Riesmeyer, Jr., 231-33 Ft. Pitt Blvd. (22). SECY, G. E. Smetak, 2793 Nobestown Rd. (5).

SOUTH CAROLINA

South Carolina: 1954. Hdqrs., Columbia. Meets, 3rd Mon. PRES, B. A. Leppard, P.O. Box 3128-A, Greenville. SECY, H. J. Haar, Jr., Garner Rd., Rte. 6, Spartanburg.

TENNESSEE

Memphis: 1944. Hdqrs., Memphis. Meets, 3rd Mon. PRES, R. H. Bolding, 107 East E. H. Crump Blvd. SECY, H. W. Wade, 4711 Poplar (17).

TEXAS

Austin: 1956. Hdqrs., Austin. Meets, 3rd Thurs. PRES, A. C. Lagow, 4506 Oakmont Blvd. SECY, Prof. J. R. Watt, M. E. Dept., University of Texas (12).

El Paso: 1956. Hdqrs., El Paso. Meets, 3rd Mon. PRES, W. A. Byars, Jr. 937 N. Clark Rd. SECY, J. H. Brooks, 4028 Hamilton St.

Fort Worth: 1957. Hdqrs., Fort Worth. Meets, 3rd Wed. PRES, T. B. Romine, Jr., 3 Wofford Bldg., 2816 Morton. SECY, C. L. Zahn, 2509 W. Berry St. (9).

North Texas: 1938. Hdqrs., Dallas. Meets, 3rd Mon. PRES, Ross Zumwalt, 929 Mercantile Securities Bldg. (1). SECY, O. H. Mehl, 6915 Lavendale Ave. (30).

South Texas: 1938. Hdqrs., Houston. Meets, 3rd Fri. PRES, E. B. Appling, 2728 Weslayan (6). SECY, H. G. McKee, 2425 South Blvd. (6).

Southwest Texas: 1946. Hdqrs., San Antonio. Meets 3rd Tues. PRES, Prof. C. L. Herndon, San Antonio College, 1300 San Pedro Ave. (12). SECY, L. A. Ingle, Jr., 722 Hildebrand.

West Texas: 1953. Hdqrs., Lubbock. Meets, 1st Tues. PRES, H. L. Mayes, Box 151. SECY, W. R. Anthony, 902 E. 34th St.

UTAH

Utah: 1944. Hdqrs., Salt Lake City. Meets, 3rd Thurs. PRES, Fred Richeda, P.O. Box 479 (9). SECY, E. V. Gritton, 2470 S. 15th (5).

VIRGINIA

Virginia: 1948. Hdqrs., Norfolk. Meets, 3rd Wed. PRES, D. C. Delinger, 424 W. 21 St. (10). SECY, J. A. Hoffman, 9522 Wells Pkwy.

WASHINGTON

Inland Empire: 1950. Hdqrs., Spokane. Meets, 1st Mon. PRES, J. A. Doyle, W. 3018 Broad. SECY, J. R. Morris, 5812 North C St.

Puget Sound (Formerly Pacific Northwest): 1928. Hdqrs., Seattle. Meets, 2nd Tues. PRES, E. W. Triol, 407 Medical Arts Bldg. SECY, R. H. Liniger, 2615 Fifth Ave. (1).

WISCONSIN

Wisconsin: 1922. Hdqrs., Milwaukee. Meets, 3rd Mon. PRES, H. W. Alyea, 507 E. Michigan St. (2). SECY, A. A. Stutheit, 2697 S. Kinnic Kinnic Ave. (7).

CANADA

British Columbia: 1952. Hdqrs., Vancouver. Meets, 2nd Wed. PRES., A. C. Martin, 425 W. Second Ave. (10). SECY, W. F. Wiggins, 1128 Burrard St. (1).

Chapitre de la Ville de Quebec: 1956. Hdqrs., Quebec, P.Q. PRES, Jean Veilleux, 350 E. Charest Blvd. SECY, R. A. Harnois, 604 St. John St., Rm. 203.

Manitoba: 1935. Hdqrs., Winnipeg. Meets, 4th Thurs. PRES, R. M. Fraser, 1855 Sargent Ave. SECY, W. L. Algie, 789 Niagara St. (9).

Montreal: 1936. Hdqrs., Montreal. Meets, 3rd Mon. PRES, D. J. McIntyre, Lafleur Bldg., Rm. 300, 3600 Barclay Ave. SECY, Paul Thibault, 1434 St. Catherine, W. (25).

Northern Alberta: 1956. Hdqrs., Edmonton. Meets, 3rd Wed. PRES, P. M. Butler, 509 Northern Hardware Bldg. SECY, G. N. Campbell, 10124 104th St.

Ontario: 1922. Hdqrs., Toronto. Meets, 1st Mon. PRES, C. L. Torry, 117 Glengrove Ave., W. SECY, H. R. Roth, 57 Bloor St., W. (5).

Ottawa Valley: 1952. Hdqrs., Ottawa. Meets, 3rd Tues. PRES, C. W. Watson, 102 Bank St., Rm. 3. SECY, A. H. Hargreaves, Dept. of Public Works (2).

Southern Alberta: 1958. Hdqrs., Calgary. PRES, H. W. Klassen, 815 Sixth St., W. SECY, P. M. Meis, 102—58th Ave., SW.

OVERSEAS BRANCH

Switzerland: 1952. Hdqrs., Zurich. PRES, Albert Eigenmann, Seestr. 105 (2). SECY, Hans Kamm, Spitalgasse 30, Bern.

STUDENT BRANCHES

North Carolina State College: 1948. Faculty Adviser: Prof. R. B. Knight, M. E. Dept., Raleigh, N. C.

Oregon State College: 1949. Faculty Adviser: Prof. G. E. Thornburgh, M. E. Dept., Corvallis, Ore.

Purdue University: 1948. Faculty Adviser: Prof. F. B. Morse, M. E. Dept., West Lafayette, Ind.

Texas A. & M. College: 1946. Faculty Adviser: Prof. L. S. O'Bannon, M. E. Dept., College Station, Tex.

University of Detroit: 1949. Faculty Adviser: Prof. J. B. Olivieri, M. E. Dept., Detroit, Mich.

University of Toronto: 1951. Faculty Adviser: Prof. F. G. Ewens, M. E. Dept., Toronto, Ont., Canada.

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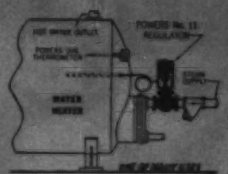

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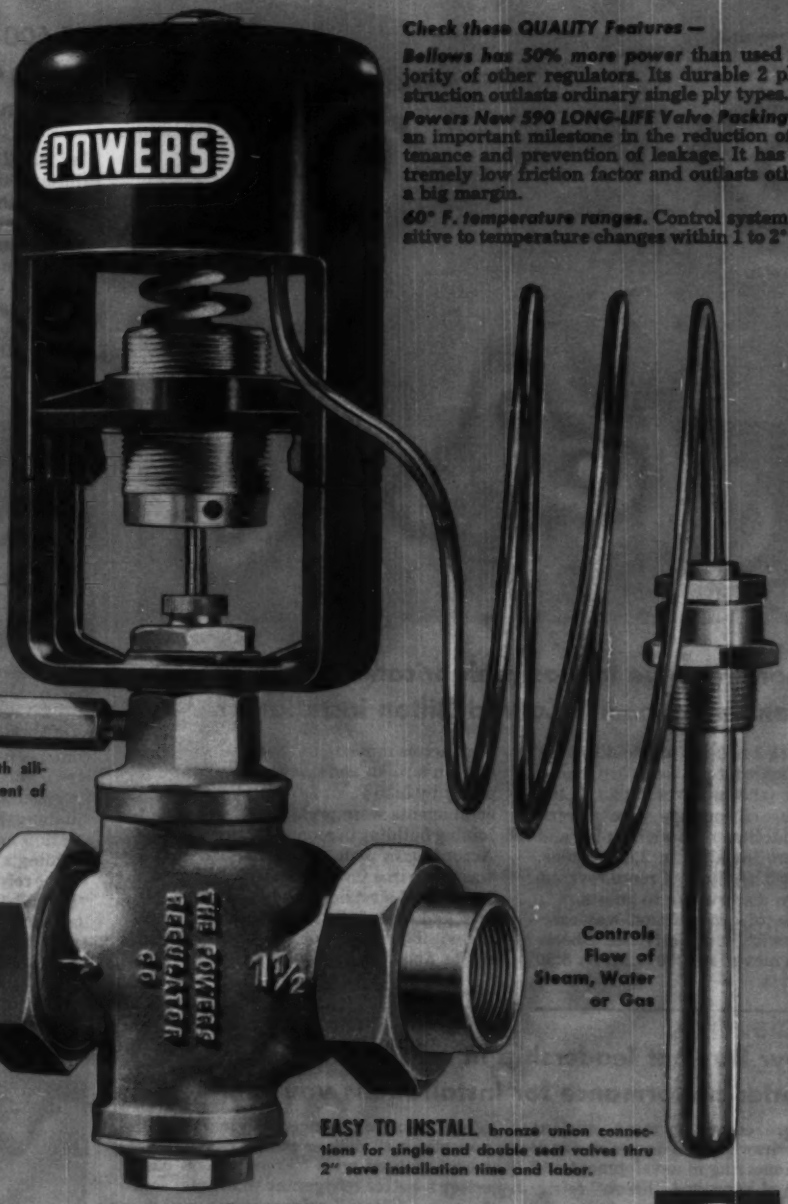

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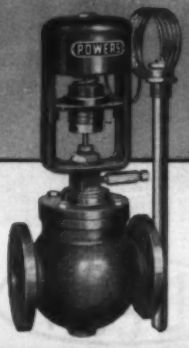

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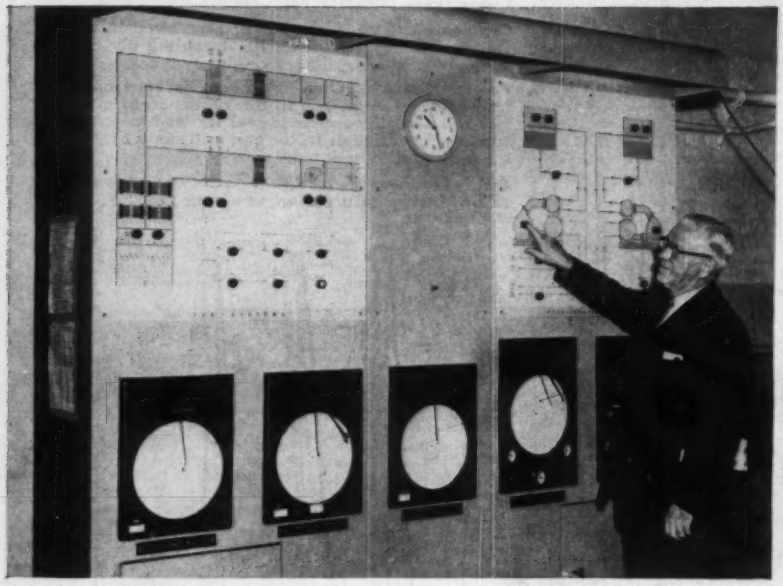
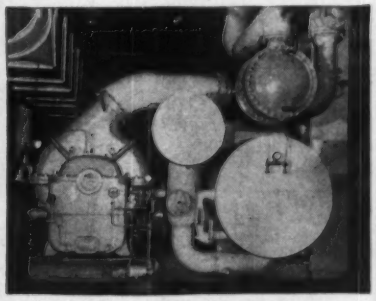


1,600-ton chilled-water system added to 2,760-room Conrad Hilton Hotel

The top 21 floors of Chicago's Conrad Hilton Hotel recently had air conditioning added with a 1,600-ton, four-zone, high-pressure induction-unit system. Two York 840-ton compressor-condenser-turbo chiller units (one shown below) chill 5,500,000 gallons of water a day for distribution to 3,400 induction units in 2,633 rooms. At left is shown the panel which controls the system. Mr. Toombs, chief engineer of the Conrad Hilton, is shown starting one



of the compressors. Left half of the panel controls fans which send filtered, washed air to each room. System is divided into four zones, each consisting of rooms with similar exposure conditions. In winter, induction units handle water heated by the building's existing steam system.

The refrigerating system is charged with "Freon"-11 refrigerant, chosen because of its proven safety, over-all economy and trouble-free performance. No maintenance problems have developed, and no "Freon" has been added to the system since it began operation.

No room revenue lost as prefabrication and careful planning expedite Conrad Hilton installation

When the York 1,600-ton air conditioning system was added to Chicago's Conrad Hilton Hotel (shown lower right), 2,400 feet of reinforced concrete were pierced and 3,400 induction units with piping and ductwork were installed in 2,633 rooms. It was done with no loss of room revenue and minimum disturbance to guests.

Each phase of construction was carefully meshed with hotel activities. Check-out time was moved to 8:00 A.M. At 8:30 contractors moved in, scheduled work was done in a room and it was ready for occupancy by 5:30 P.M. Ductwork and piping components were prefabricated in an adjoining building in room-by-room sections. According to plan, each room installation was made in a few hours after drilling and location of electrical feeders, service outlets and telephone lines had been completed. The whole job was finished three weeks ahead of schedule.

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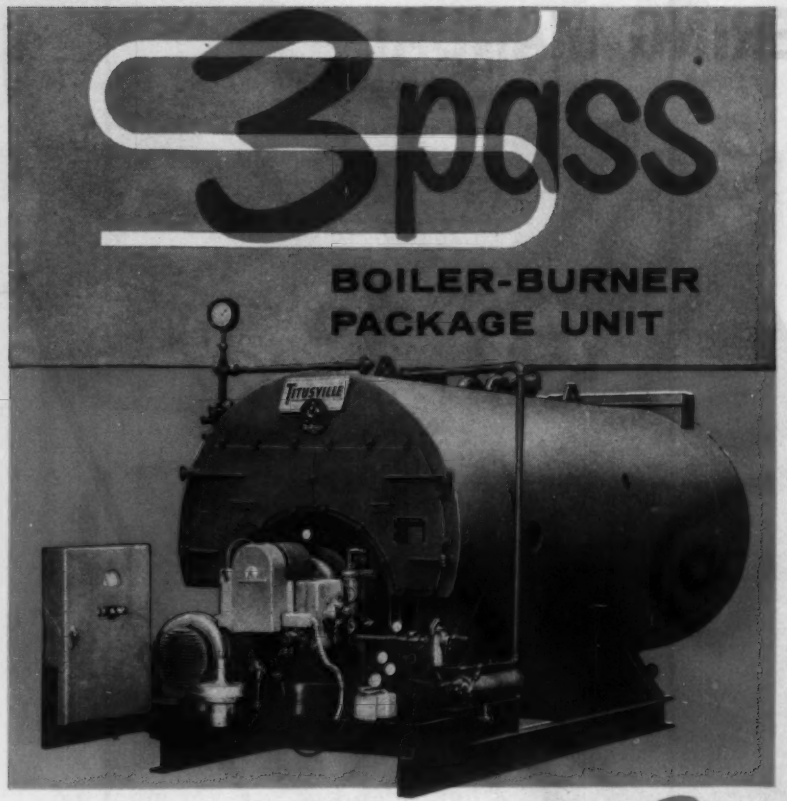

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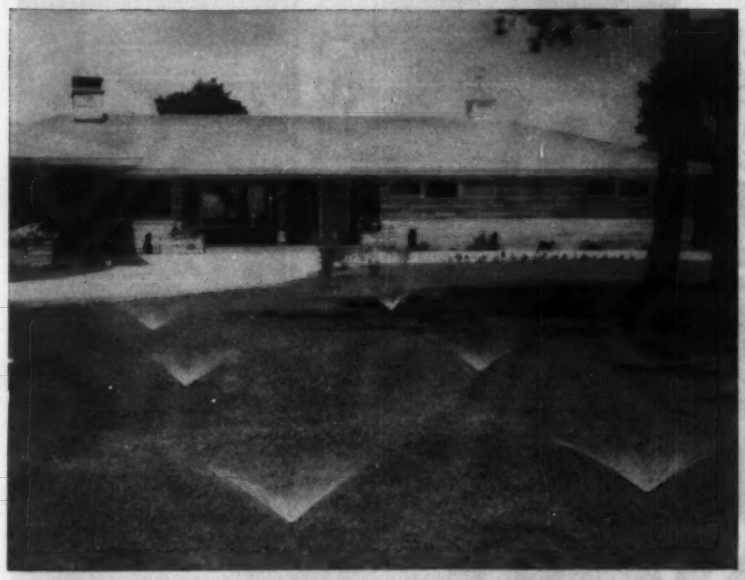
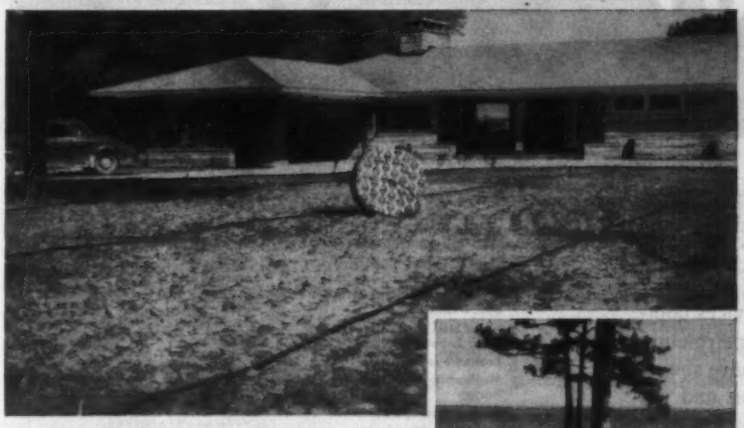
25,000-sq.-ft. sprinkler system of NATIONAL* Polyethylene Pipe installed by 3 men in 2 days





Lines of **National** Polyethylene Pipe laid out, with sprinkler heads installed.

An unending source of water—West Grand Traverse Bay—in the back yard.

IN THIS RESIDENTIAL LAWN SPRINKLER SYSTEM, located in Traverse City, Michigan, are 2,429 feet of USS NATIONAL Polyethylene Pipe in sizes of ¾", 1", 1¼" and 1½". The system includes 105 sprinkler heads, both pop-up and rotary types. Pressure at the heads is 65 pounds; flow rate is 50 gallons per minute.

Installed in just two days, the system covers a lawn area of 25,000 sq. ft. The water is drawn from West Grand Traverse Bay which is adjacent to the property.

USS NATIONAL Polyethylene Pipe is flexible, light, easy to handle, quick to install. Cut it with a knife or hacksaw. Connect it with insert fittings and stainless steel clamps. Acids, salts, alkalis, and other soil chemicals can't harm it. And Polyethylene Pipe remains pliable and workable in temperatures from −90°F. to +120°F. It is made from 100% virgin polyethylene to which 2% of an inert black pigment filler has been added to prevent deterioration from ultraviolet rays.

For full information, write to National Tube Division, United States Steel Corporation, 525 William Penn Place, Pittsburgh 30, Pa. Request Bulletin No. 29. *Trademark

This seal of the National Sanitation Foundation means Tested... Approved... Sanitary!

National Tube Division of USS United States Steel

Columbia-Geneva Steel Division, San Francisco, Pacific Coast Distributors • United States Steel Supply Division • United States Steel Export Company, New York

A Bronze yoke bushing nut
B Handy grip iron wheel
C Bronze yoke bushing
D Iron yoke cap with zerk fitting for lubricating bushing
E Steel yoke cap bolts and nuts
F TYPE 316 STAINLESS STEEL spindle
G NI-RESIST CAST IRON, TYPE 2, yoke
H Bronze eye bolt nuts
I Malleable iron gland flange
J Steel gland eye bolts
K Steel gland lug bolts and nuts
L TYPE 316 STAINLESS STEEL gland
M Teflon impregnated asbestos packing
N TYPE 316 STAINLESS STEEL bonnet bushing
O NI-RESIST CAST IRON, TYPE 2, bonnet
P Steel bonnet bolts and nuts
Q TYPE 316 STAINLESS STEEL spindle ring
R Asbestos gasket
S TYPE 316 STAINLESS STEEL wedge pin
T NI-RESIST CAST IRON, TYPE 2, through-port body
U TYPE 316 STAINLESS STEEL solid I-beam wedge
V TYPE 316 STAINLESS STEEL seat rings

Wherever valves are attacked by acids, salt and alkaline solutions, sea water, brine or other corrosive fluids, vapors or gases, "Jenkins Ni-Resist Gate Valves" are *fighting* words.

In a wide range of corrosive and erosive services common to the chemical, food, plastics, marine, petroleum, and pulp and paper industries, these valves have shown a remarkable ability to withstand corrosion and cut valve costs.

The secret of their long, trouble-free service is the combination of Ni-Resist type 2 cast iron and type 316 stainless steel trim, plus Jenkins *extra value* construction throughout. No other gate valves offer this combination for fighting corrosion.

When choosing Ni-Resist valves, let the famous Jenkins Diamond be your guide. Specify "JENKINS NI-RESIST" — for longer valve life. Write us, or ask your Jenkins Distributor for information folder No. 205. Jenkins Bros., 100 Park Avenue, New York 17.

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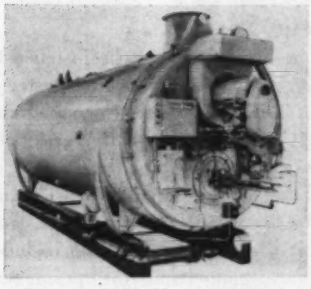
LOOK FOR THE JENKINS DIAMOND
VALVES
JENKINS SINCE 1864

Sold Through Leading Distributors Everywhere

EQUIPMENT DEVELOPMENTS . . .

For reviews of Recent Trade Literature see Page 222



Packaged Boilers . . .

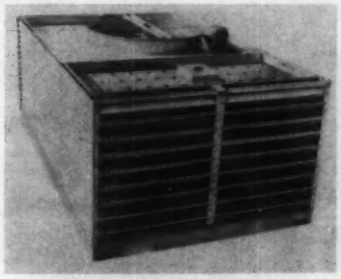
. . . in 250, 300, 350 hp sizes—*Cleaver-Brooks Co., Dept. HPAC,* 326 *E. Keefe Ave., Milwaukee* 12.

"Model CB" line is said to offer following new developments: inspirating pilot establishes pilot flame with no gas pressure; single tip retractable nozzle mixes air, oil, removable for quick cleaning; rotary air damper provides air modulation without vibration. Air atomizing burner on boiler is single tip, retractable type with stationary diffuser, nozzle. No high speed moving parts. Single blower runs both burner, compressor. Boilers incorporate forced draft, four-pass construction that is said to provide 80 percent efficiency from 30 to 100 percent of full rating. Insulated with glass fiber.

Steam Trap . . .

. . . for automatic evacuation of condensation, air from systems—*Sarco Co., Inc., Dept. HPAC,* 635 *Madison Ave., New York* 22.

"Thermo-Dynamic" unit operates without leakage or loss of steam through bleeder ducts, orifices during time seating member is seated, according to manufacturer. Seating member is solid stainless steel disc. Available for steam pressures from 10 to 600 psi.



Cooling Towers . . .

. . . with low silhouette, capacities upward from 75 tons—*J. F. Pritchard Co. of Calif.,* 4625 *Roanoke Pkwy, Kansas City, Mo.*

"Lo-Line" cooling tower has all steel structural members that are hot dipped galvanized after fabrication for corrosion protection. Louvers, casing, distribution system, fan deck are asbestos cement for fire protection. Heart grade redwood used in deck fill and drift eliminators. Designed to conform to standard municipal fire codes.

Flexible Tubing . . .

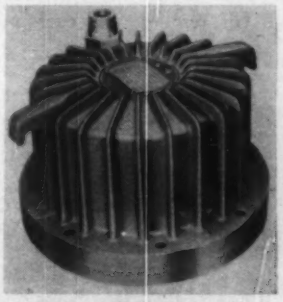
. . . extruded from high impact styrene copolymers, polyvinyl chloride—*Carlon Products Corp., Dept. HPAC,* 10225 *Meech Ave., Cleveland.*

Lightweight, flexible, high pressure "Kralastic" PVC tubing intended for use in instrument control lines handling liquids and gases, coolant and fuel lines, propane and butane lines, air conditioning and refrigerating units. Working pressure of ¼ in. PVC tubing rated at 565 psi at temperature of 73.4 F. Available in standard sizes of 3/16 to 1 in. in coiled lengths of 250, 500 ft. Tubings may be cut with tube cutter. Standard brass compression, flared fittings recommended for use with tubing; regular flaring tool used for flared type fittings.

Shutoff Valve . . .

. . .for service with air, water, gas, oil—*Homestead Valve Mfg. Co., Dept. HPAC, P.O. Box* 348, *Coraopolis, Pa.*

According to manufacturer, "Figure 202" offers positive seating by spring, line pressure; replaceable resilient disc for positive seal; full opening by 90 degree movement of handle; cam to hold handle in open position. Available in ⅜, ½, ¾ in. sizes for use on pressures to 150 lb at temperatures to 250 F.



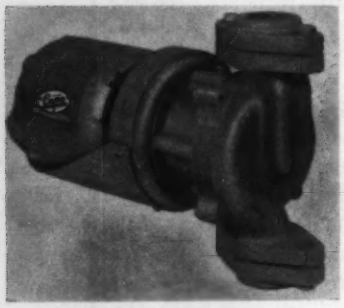
Immersible Motor . . .

. . . designed for close coupling to agitators or pumps for submerged operation—*Louis Allis Co., Dept. HPAC,* 427 *E. Stewart St., Milwaukee* 1.

Flange-mounted motor eliminates many connecting components, such as intermediate bearings, couplings, shafting, special bases, etc., says company, since motor shaft is directly attached to impeller. Motor, pump

EQUIPMENT DEVELOPMENTS
Continued

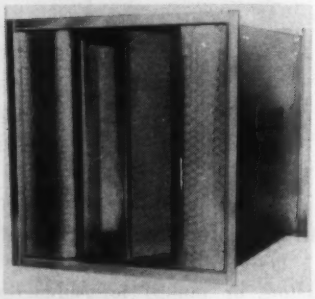
can be raised, lowered into position together by motor's lifting lugs. Available in ratings ¾ to 40 hp.



Booster Pump . . .

. . . features quiet operation, is adaptable for either horizontal or vertical installation—*Piqua Machine and Mfg. Co., Dept. HPAC, Piqua, Ohio.*

Redesigned "Enpo" booster pump has motor separate from the pumping unit—clear of motor shaft—mounted in rubber to eliminate motor noise, says manufacturer. Available in standard iron body or all bronze, units are equipped with automatic overload protective device to prevent burnouts in case of low voltage or overheating. Bronze impellers used to resist rust. Oversize bearings, oiled by circulating lubrication system, also bronze, diamond bored. Oil reserve with each pump.



Duct Silencer . . .

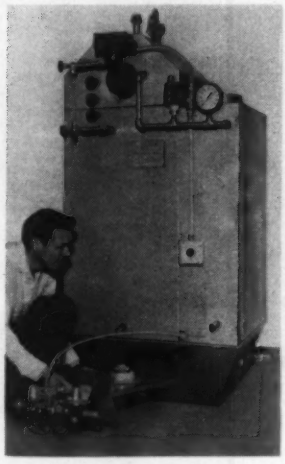
. . . designed to reduce installation costs—*Industrial Acoustics Co., Inc., Dept. HPAC, 341 Jackson Ave., New York 54.*

"Mod-U-Silencers" are available in full sizes 24 × 24 × 30 in.; in half sizes, 24 × 12 × 30 in.; quarter sizes 12 × 12 × 30 in. Can be installed in parallel to handle large volumes, placed in series for additional noise control. Unit also available with slip joint connections.

Heat-Transfer Medium . . .

. . . for snow removal systems—*Dow Chemical Co., Dept. HPAC, Midland, Mich.*

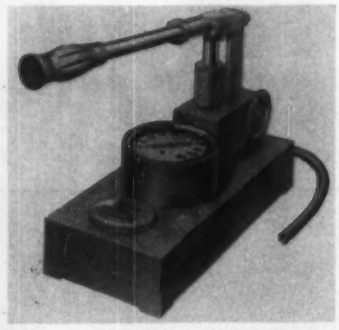
"Dowtherm SR-1" contains phosphate type corrosion inhibitor, circulates in snow removal systems at approximately 140-160 F. May be heated with steam in shell-and-tube exchanger or directly in boiler. Adaptable for snow removal from sidewalks, driveways, ramps, loading areas, other potential danger areas.



Steam Boiler . . .

. . . requires less than third of floor space of boilers of equal power—*Hercules Power Equipment Co., Dept. HPAC, P. O. Box 49724, Barrington Sta., Los Angeles 49.*

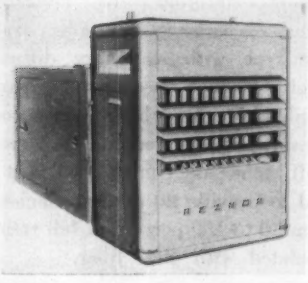
"Thermodyne" is water-tube type boiler on vertical bent-tube concept. Vertical arrangement of boiler's tubes gives 80 percent thermal efficiency. Tubes are filled with liquid, heated in three-pass baffle system where gases vary from approximately 2000 to 400 F. Steel drums of 18 to 42 in. have working pressures of 15 to 250 psig. Water tube unit is also of steel construction. Available in 14 variations of 3 basic units, 5 to 1000 hp. All units designed for low or high pressure and low or high temperature water circulation.



Valve Tester . . .

. . . weighs 17 lb, can be fastened to bench and used as portable tester—*Farris Engineering Corp., Dept. HPAC, 400 Commercial Ave., Palisades Park, N. J.*

Unit consists of 3000 psi hand operated pump, pressure gage, reservoir base. "Hydrokit" also includes pressure connection for permanent piping, but is primarily designed for use without external power source. Standard pressure gage is zero to 500 psi, other gages zero to 3000 psi available. Other accessories include hydraulic flexible tubing, steel carrying case. Unit can be used to test process piping, pressure vessels, boiler tubes, heat exchanger shells, test chambers, pump casings, etc.

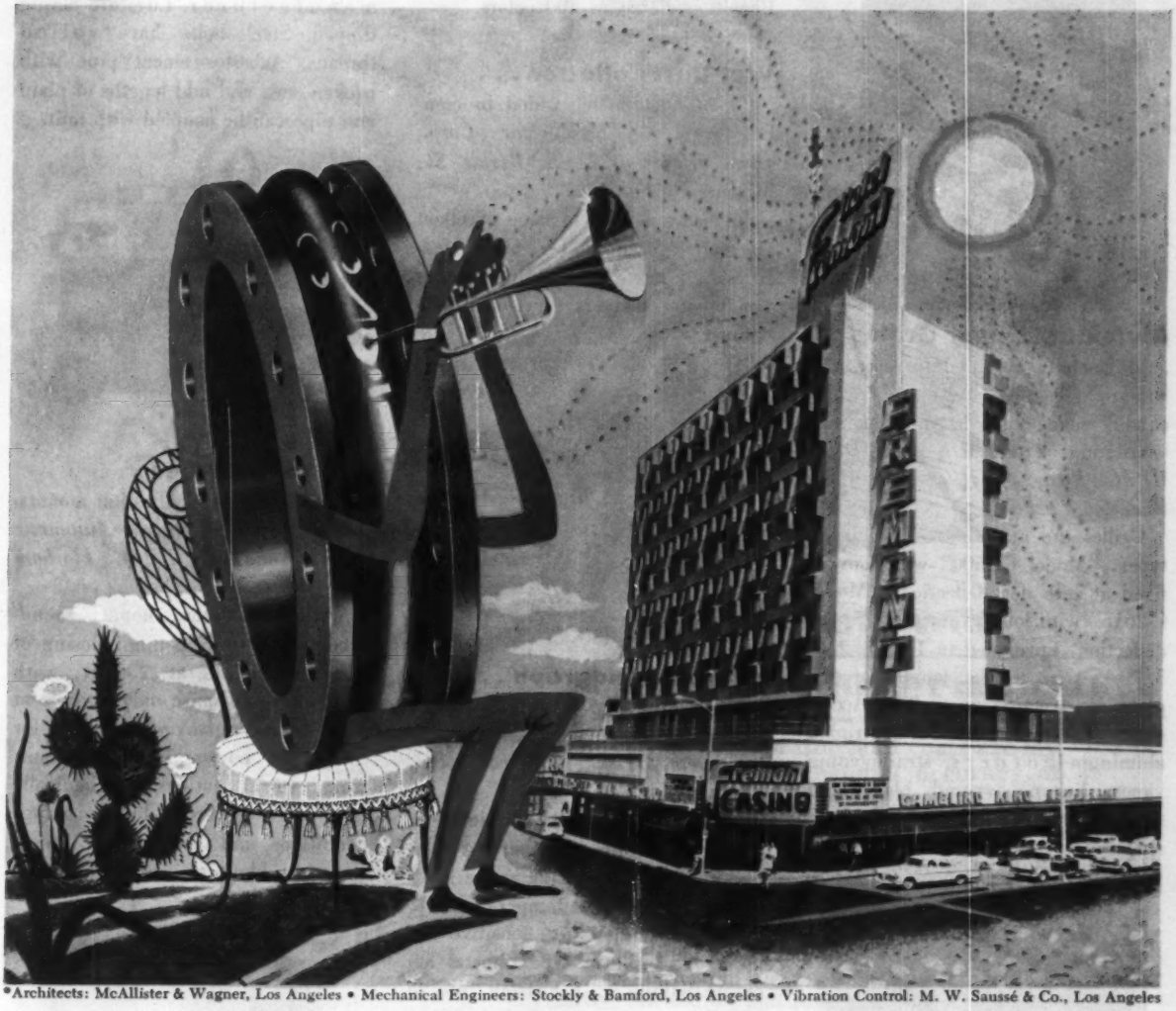


Unit Heater . . .

. . . with quiet operation, improved appearance—*Reznor Mfg. Co., Dept. HPAC, Mercer, Pa.*

Company's new line intended for use in libraries, churches, hospitals, banks, other buildings where low noise level is consideration. Blower, controls completely enclosed in "Series BE" model. Heaters equipped for operation in duct systems with external static pressures up to 0.2 in. Available in 11 sizes 25,000 to 300,000 Btu. Unit is shipped completely assembled, ready for installation.

US RUBBER EXPANSION JOINTS



*Architects: McAllister & Wagner, Los Angeles • Mechanical Engineers: Stockly & Bamford, Los Angeles • Vibration Control: M. W. Saussé & Co., Los Angeles

Playing it real cool...at Las Vegas

The revolutionary new cantilevered-floor Hotel Fremont* in downtown Las Vegas is the tallest building in Nevada. Of course, it has the latest in air-conditioning. And that was a big problem to lick.

Subsurface water drainage, plus space-cost considerations, meant that all hotel mechanical equipment had to be located on the 11th floor. Would the air-conditioning pumps transmit vibration to the other floors? Would there be more rattle and roll in the pipes than in the game room?

Not if U.S. Rubber Expansion Joints were installed in the water lines, figured the vibration control engineers who had learned of their efficiency on other jobs. They installed four joints in the system, the first high-pressure, double-duct system used in Nevada. And the Fremont Hotel stays real cool and *quiet*.

These economical, flexible pipe line connections take up the stresses due to vibration, expansion and contraction in water and freon lines. They prevent the transmission of noise, and take care of misalignment. Service life is long because there are no moving parts to wear or bind.

These joints—plus expert engineering service—are obtainable at your local "U.S." Distributor, at any of the "U.S." District Sales Offices or write us at Rockefeller Center, New York 20, N. Y. In Canada, Dominion Rubber Co., Ltd.

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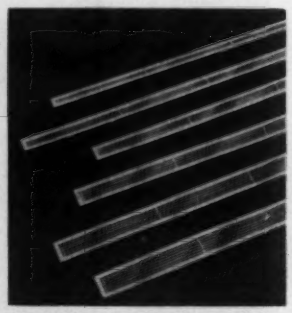
EQUIPMENT DEVELOPMENTS

Continued



Aluminum Linear Grilles

. . . specially designed for sidewall, window sill, floor use, said to be equally efficient for heating, cooling, ventilating—*Titus Mfg. Co., Dept. HPAC, Box* 810, *Hiway* 20 *West, Waterloo, Iowa.*

Grilles are available in two basic types: "Model C-2500" with louvers fixed at zero deg deflection; "Model C-2615" with louvers fixed at 15 deg deflection. Furnished in 1½, 2, 2½, 3, 3½, 4 in. widths, lengths of one piece construction up to 8 ft. Accessories include choice of extruded aluminum borders, straightening vanes, linear, opposed blade and multi-shutter dampers, blank-off strips.

Radiant Ceiling . . .

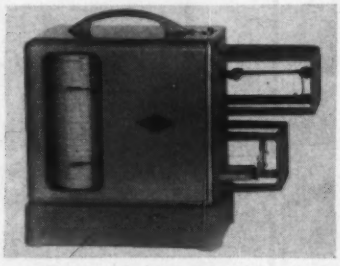
. . . designed to provide radiant heating, cooling along with acoustical qualities in noise reduction—*Airtex Corp., Dept. HPAC,* 2900 *N. Western Ave., Chicago* 18.

Ceiling designed around "Airtex" radiant panels, made of solid aluminum in standard 12 × 24 in. size. Can be used with any standard acoustical tile. Thermal heat bridges incorporated into back of panels, spaced 6 in. apart, 3 in. from each side. Water pipes connected to square shaped headers. Items available for installation of ceiling include: panels, T-bar clips, coil clips, square headers, suspension channels. Panels available in 400 colors.

Wet Dust Collector . . .

. . . in new model added to company's line—*Wheelabrator Corp., Dept. HPAC,* 1321 *S. Byrkit St., Mishawaka, Ind.*

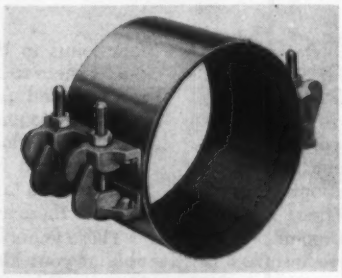
Collector is said to have excellent efficiency performance. Cited features: no moving parts, no nozzles nor pumps, delivers air free of entrained water.



Hygrothermograph . . .

. . . with specially designed animal membrane diaphragm — *Serdex, Inc., Dept. HPAC,* 12 *Bowdoin Sq., Boston* 14.

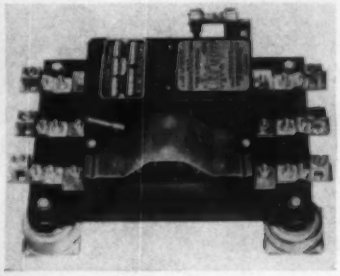
"Model HGS-HYT-1" is said to be repeatable within ± 3 percent relative humidity. Operating range is 15 to 95 percent RH at temperatures 32 to 130 F. Temperature sensitive element of cantilever type bimetal accurate within ± 1 F from zero to 100 F, says company. Unit is 12 × 15 × 6 in., weighs 11¼ lb.



Pipe Repair Clamp . . .

. . . of stainless steel and Grade A malleable iron — *Dresser Mfg. Div., Dresser Industries, Inc., Dept. HPAC, Bradford, Pa.*

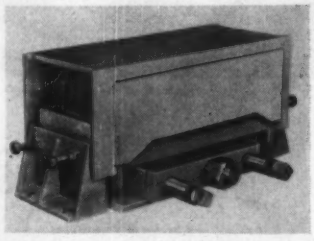
"Dresser 360" designed for repairing full breaks or holes in asbestos-cement and cast iron water lines. Lug design insures against bolt bending, assures uniform gasket pressure, says manufacturer. Lugs are plastic dipped. Steel bolts have rolled threads. Asbestos-cement pipe with broken ends and odd lengths of plain end pipe can be coupled with unit.



Control Switches . . .

. . . equipped with vibration mounts, in soundproof enclosures—*Automatic Switch Co., Dept. HPAC, Florham Park, N.J.*

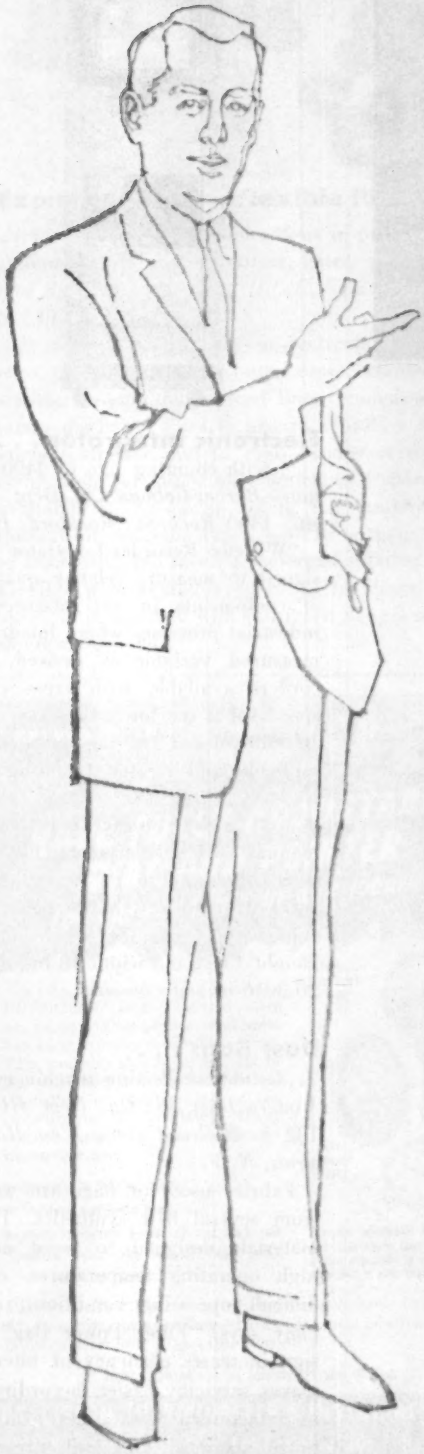
Without vibration mounts, soundproof enclosures, opening, closing of switches audible at 250 ft; with their addition, noise only audible at 3 ft says company. Line used for control of power, lighting circuits from central stations. Mechanically held, so are unaffected by line voltage conditions, and respond only to control of pushbuttons.



Vibration Absorbers . . .

. . . designed to simplify installation of heavy equipment — *Korfund Co., Inc., Dept. HPAC,* 48-01-*F,* 32*nd Pl., Long Island City* 1, *N. Y.*

Type "SW" mountings—vibration, shock, noise isolators utilizing steel springs as isolation medium—available in seven load carrying capacities ranging 38,000 to 125,000 pounds each. Lengths range 20 to 35 in.; widths 12 to 20 in. Units adjusted, leveled from sides. Flat top permits placing equipment in many positions under machine base.



"I cut piping costs with B&W Welding Fittings!"

"Minimum installation time and costs are my responsibility. The dimensional accuracy of B&W Welding Fittings permits quick and positive welding with no erection delays."

Cutting costs is everyone's responsibility. In a piping system, using welding fittings that align accurately is one sure way of saving time and money — in installation and in maintenance. The dimensional accuracy of welding fittings like this B&W Ell assures you of trouble-free fabrication and installation. Their true circularity, full radius, and walls of uniform thickness will enable you to make your piping dollars go farther. Write for bulletin FB504.

B&W Welding Fittings and Forged Steel Flanges are available in carbon steel and the B&W CROLOYS.

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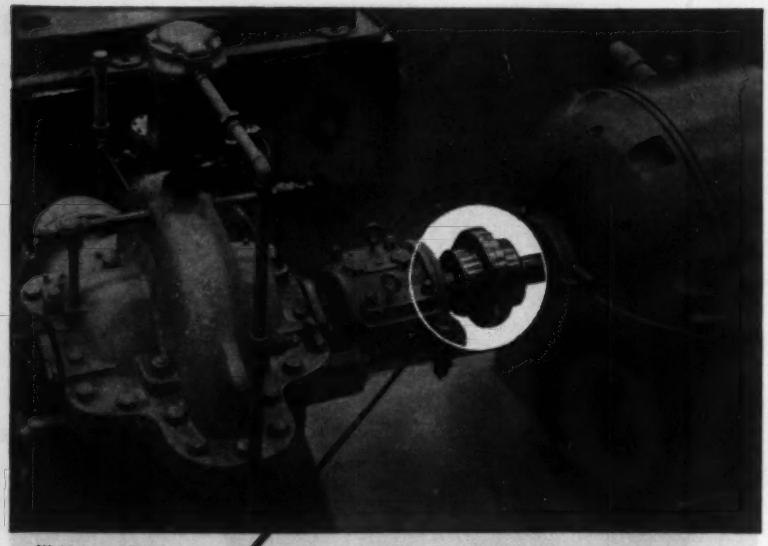
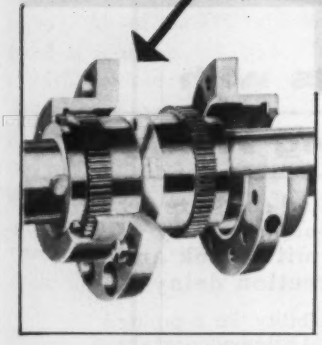


Waldron coupling on centrifugal pump installation

WALDRON

flexible couplings...



USED IN HUNDREDS OF DIFFERENT APPLICATIONS BUT ALWAYS FOR THE

same 3 reasons

1 STRENGTH — Hubs and cover sleeves for sizes 1¼A through 7A are machined from tough steel forgings. Hubs are keyed to the shafts. The two one-piece cover sleeves function as a single, rigid unit serving as a floating connecting link between the hubs. High strength of forgings makes possible a very compact coupling with low rotating inertia.

2 RELIABILITY — There are no flexible parts to bend or break and the coupling is dust, moisture, and oil tight. Patented Walflex seal is at the lowest possible diameter where centrifugal force is least. Clearance between teeth in hubs and sleeve is engineered so that an oil wedge always separates them, taking the wear.

3 SERVICE — Plenty of rough bore couplings, already assembled—on the shelf for *immediate* delivery. Finish bored standard couplings shipped to meet customers' schedules. We are geared up to give you realistic delivery on *any* type of couplings.

Ask for Catalog 57

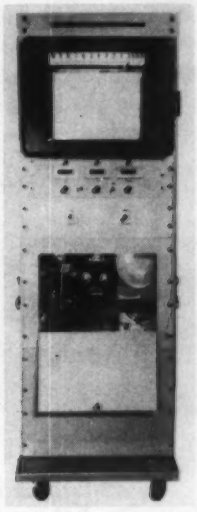
JOHN **WALDRON** CORP.

NEW BRUNSWICK, NEW JERSEY

Representatives In Principal Cities
Export Agents—Frazar & Co., New York, N. Y.

EQUIPMENT DEVELOPMENTS

Continued



Electronic Integrator . . .

. . . with counting rate to 2400 per min—*Barber-Colman Co., Dept. HP-AC, 1300 Rock St., Rockford, Ill.*

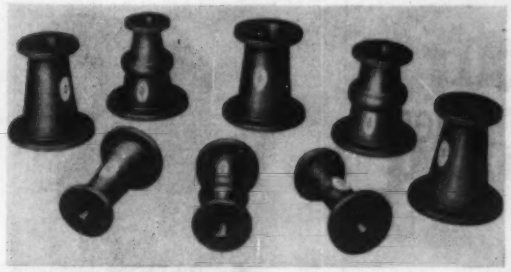
"Wheelco Recorder-Integrator" designed to measure relative quantity of components in gas mixtures in industrial processes where integrated measured variable is desired. Recorders available with cross chart speeds of 2 sec for scale spans 1 to 10 millivolts, 1 sec for spans of 10 millivolts and greater. Counting rate is 2400, 1200, 600 counts per min at full scale reading, selective by manual switch. Pen motor is magnetic. Accurate to ± 1 percent at point of reading. Operates on 115 volts, at 60 cycle, 150 VA regulated. Height 13 7/8 in., width 18 in., depth 20 3/16 in. with recorder.

Dust Bags . . .

. . . for dust collecting machinery — *Modern Dust Bag Co., Dept. HPAC, 132 E. Railroad Ave., West Haverstraw, N. Y.*

Fabrics used for bags are woven from several new synthetics. These materials designed to resist acids, high operating temperatures, other difficult operating conditions, company says. "Filter Power Bag" design increases efficiency of filtering, makes servicing easier, according to manufacturer. Stock sizes available to fit standard dust collecting machinery.

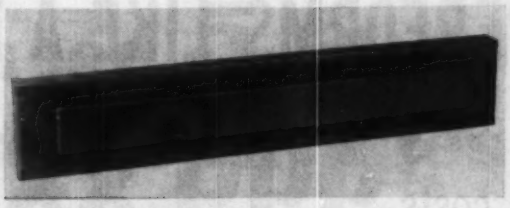
EQUIPMENT DEVELOPMENTS — *Continued*



Expansion Joints, Flexible Pipe . .

. . . for use as flexible connections in pressure, vacuum systems handling water, brine, gases, chemicals—*General Rubber Corp., Dept. HPAC, Summit and Atwood St., Tenafly, N. J.*

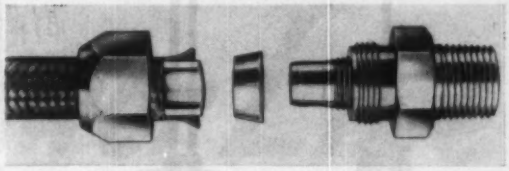
Recommended for use in recirculating water systems, hot water lines, water cooler condenser lines, washer systems, boiler feed lines, chilled water lines, pump discharge lines to absorb vibration and noise; prevent stresses due to pipe expansion contraction; compensate for minor misalignments. Expansion joints available ½ to 72 in. diam in standard straight-through or reducing types, with or without filled arch or liner, with full faced or enlarged slipover pipe ends. Flexible pipe available ½ to 72 in. diam in lengths up to 50 ft, finished with full faced flanges or enlarged slipover pipe ends.



Baseboard Heaters . . .

. . . with heating element of aluminized steel — *Electrovector, Inc., Dept. HPAC, 475 Flushing Ave., Brooklyn 5.*

"Dual-Fin" heaters have no top nor bottom, may be reversed without disassembly. Systems available in 750, 1500, 2000 watts. Dimensions are 2⅞ in. wide, 6½ in. high, lengths of 36, 72, 96 in.



Plastic Hose Assembly . . .

. . . with detachable, re-usable fittings—*Titeflex Corp., Dept. HPAC, Hendee St., Springfield 4, Mass.*

Inner core of "Springfield 140" is reinforced with stainless steel wire braid for high pressures. Hose is chemical, corrosion resistant in temperature range of −100 to 500 F. Each fitting consists of three pieces.

PRINCO DIAL THERMOMETERS

HAVE FULLY ADJUSTABLE DIAL AND POINTER for easy reading in any location

Sturdy, sensitive, accurate PRINCO 4" Dial Thermometers are made so that pointer and scale can be set to any desired position. This permits the reading axis of the thermometer to be vertical regardless of the position of the instrument. In addition, these smooth operating, precise thermometers are:

- accurate to 1% of range
- moisture and fume proof
- made in bottom connected and back connected styles with stainless steel stems and connector nuts

Complete adjustment of pointer and scale means reading axis is always adjustable to 12 o'clock regardless of stem angle.

PRINCO Dial Thermometers are also available in 2" and 3" diameter, fume and moisture proof case of all stainless construction and adjustable dial only.

Write, wire or call for information and catalog.

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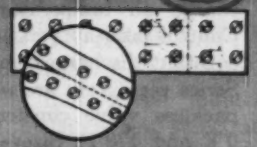
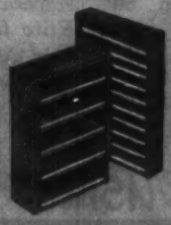
ELIMINATES
Layout—Tab Cutting, Hole Punching, Riveting, Spot Welding, Etc.





Split (½) Rail for Louver thicknesses from 1¼ to 1⅜". Use Full Size Rail for Louver thicknesss from 3¼" to 4".

Try this economical and practical method for fabricating Louvers — removable, hinged, or stationary. Louverail is 24 ga. galv. 4½" wide in (2—50' lengths) 1 right and 1 left coiled together. Hundreds of variations possible.

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1111 North 5th Avenue Phone FA 3-0354 Birmingham, Alabama

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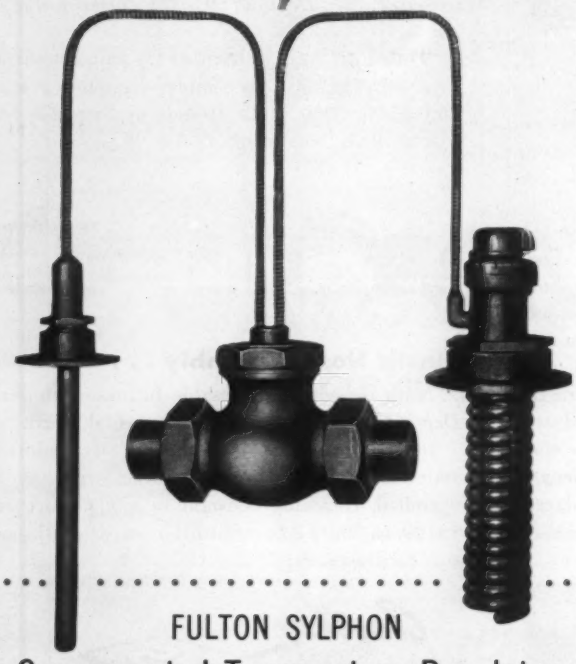


FULTON SYLPHON

Compensated Temperature Regulator

CONTROLS HEATING AND VENTILATING SYSTEMS

These low-cost single valve regulators provide dependable modulating control of heating and ventilating systems. An even discharge air temperature is maintained, irrespective of demand. Control bulb automatically adjusts to prevent "droop" when a constant discharge temperature is wanted. All Sylphon No. I-928 Series regulators are self-powered and feature premium quality packless valve construction. 60° temperature ranges between 0°F and 170°F. Sizes—½" to 2". Write for complete data on No. I-928 Series Temperature Regulators. Ask for Catalog D-GH.

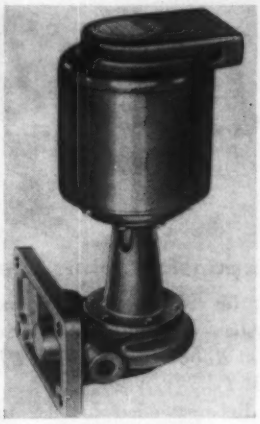
Mr. Controls®

Robertshaw-Fulton CONTROLS COMPANY

FULTON SYLPHON DIVISION • Knoxville 1, Tennessee

EQUIPMENT DEVELOPMENTS

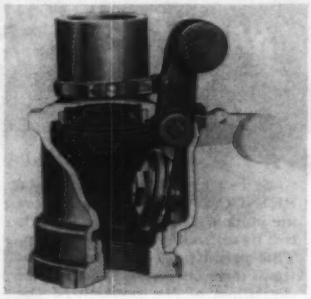
Continued



Sealless Pump . . .

. . . with triple discharges to be used individually, simultaneously, or in any combination—*Ruthman Machinery Co., Dept. HPAC,* 1809 *Reading Rd., Cincinnati* 2.

Pump is available in two lengths, has no seals or metal to metal contacts. Developed for handling clean coolants, liquids containing grit, abrasives. Available with 1/10 hp, 1725 or 3450 rpm motor or ¼ hp, 3450 rpm motor for heads up to 30 ft, capacities up to 30 gpm.



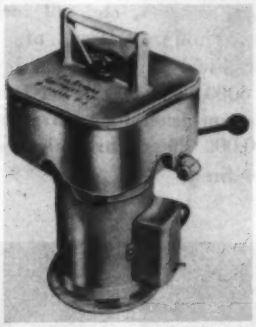
Safety Valve . . .

. . . designed to close automatically in case of fire or accidental bumping —*Jordan Industrial Sales Div. of OPW Corp., Dept. HPAC,* 6013 *Wiehe Rd., Cincinnati* 13.

"No. 10" safety valve shuts off flow of volatile liquids, preventing or starving fire. Made of cast iron, with disc for tight shutoff in 1, 1¼, 2 in. sizes. Recommended for use in industrial applications such as paint, solvent, chemical lines.

EQUIPMENT DEVELOPMENTS

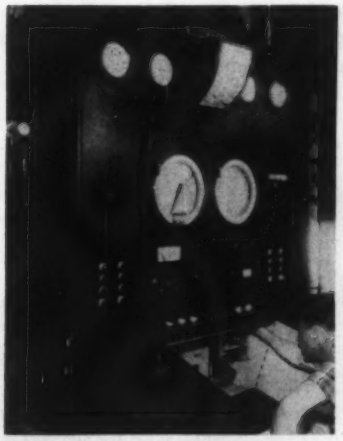
Continued



Hydraulic Motor Pump . . .

. . . develops up to 10,000 psi, weighs 65 lb.—*Tal Bending Equipment, Inc., Dept. HPAC, 417 N. Water St., Milwaukee 2.*

Pump rated at 5000 psi continued duty, delivering 80 cu in. of oil per min; driven by standard ½ hp single phase 60 cycle 1750 rpm 110-220 volt motor. Can be used wherever hydraulic power is used, or to replace mechanical power, says manufacturer.



Combustion Control . . .

. . . systems for varying boiler requirements—*Hays Corp., Dept. HPAC, 800 E. Eighth St., Michigan City, Indiana.*

Company's line of 10 standardized systems of control consists of completely piped, wired free standing panel containing all instrumentation, control necessary for full automatic operation of single gas and/or oil fired boilers. Control, shutoff valves,

These 5 big plus advantages prove you're right to choose

Power Line

for your industrial ventilation requirements

1. Complete line: Broadest product line of air-moving equipment for every industrial requirement.

2. Certified performance: All Power Line Fans are rated by PFMA and by NAFM.

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5. Sold only through qualified ventilation specialists. You get expert technical advice and service from the survey of your requirements right through to the completion of your installation.

YOURS ON REQUEST: Big 20-page Power Line Catalog gives complete facts about industrial ventilation, including selection of proper type and size of fan, calculation of duct resistance, and installation procedures, plus features, dimensions, specifications and performance data. Without obligation write for your free copy of Catalog No. 38A.

POWER LINE FAN COMPANY, INC.

Subsidiary of **Chelsea Products, Incorporated** 639 South Avenue, Plainfield, New Jersey

New **ACE RIVICLOR®**

Corrosion-resistant plastic piping

RIVICLOR, newest of all rigid plastic pipe, heads the list for resistance to chemicals and excellent aging characteristics . . . plus high strength, toughness and easy workability.

Riviclor is unplasticized polyvinyl chloride, specially formulated for process piping. Non-toxic, non-flammable, excellent insulating properties. Only half weight of aluminum. Never needs painting. Smooth inner surfaces give you high flow rates with low loss of head.

Approved For Use With Drinking Water

Use Riviclor for all in-plant piping of mild or strong corrosives at normal temperatures . . . for liquid lines where "sweating" or corrosive vapors are problems . . . for underground piping. Pipe, fittings, diaphragm valves from ½" to 2".

Ask for Technical Bulletin CE-56.

ABBREVIATED TABLE OF CHEMICAL RESISTANCE

ACIDS		BASES		MISCELLANEOUS			
Acetic 50%	S	Ammonium Hydroxide 28%	S	Ethyl Alcohol	S	Carbon Tetrachloride	S
Chromic 25%	S	Sodium Hydroxide 50%	S	Methyl Ethyl Ketone	U	Plating Solutions	S
Hydrochloric 38%	S	HALOGENS		Gasoline	S	Photographic Solutions	S
Hydrofluoric 50%	L	Sodium Chloride Sat.	S	Mineral Oil	S	KEY: S—Satisfactory	
Nitric 20%	S	Ferric Chloride	S	Animal Oil	S	L—Limited to certain applications	
Sulphuric 50%	S	Sodium Hypochlorite 5%	S	Vegetable Oil	S	U—Unsuitable	
Sulphuric 98%	S			Phenol 10%	S		
				Chlorine 5%	L		
				Alum	S		

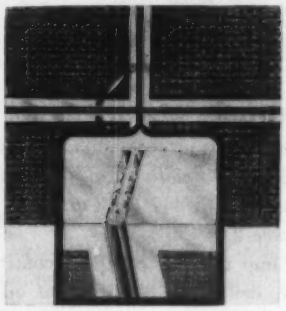
ACE processing equipment of rubber and plastics

AMERICAN HARD RUBBER COMPANY
DIVISION OF AMERACE CORPORATION
Ace Road • Butler, New Jersey

EQUIPMENT DEVELOPMENTS

Continued

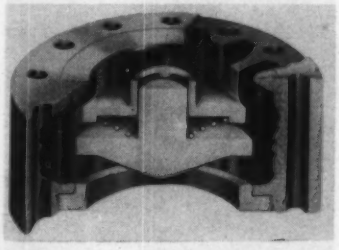
pressure switches, etc., all included within piping, wiring of panel proper. Field of application is from small 6000 to 10,000 lb per hr packaged steam generator to large 60,000 to 100,000 lb per hr boilers, single burner fired.



Filter Gasket . . .

. . . said to provide lifelong dusttight seal between filter, filter holding frame—*George Evans Corp., Dept. HPAC, River Dr. at 37th St., Moline, Ill.*

"Seal-Tight" gasket exerts inward pressure of 4.1 lb per lineal in., molds to contour of filter. Gasket not affected by oil or moisture; does not support combustion.



Check Valve . . .

. . . for control of water hammer for all types of hot, cold liquid service where flow is constant—*Williams Gauge Co., Inc., 2 Gateway Center, Pittsburgh 22.*

Available in sizes 1 to 10 in.; faced, drilled in accordance with ASA standard for pressures 125 to 2500 lb. Valve can be furnished with special flange facings, including large male and female, ring joint, large tongue and groove. Valve can be used in any position.

(*Continued on page* 194)

ANOTHER FIRST FROM TUBE TURNS...

LIGHT WEIGHT FITTINGS for lower-cost piping

Light weight piping makes practical the use of larger pipe for greater flow area, and it cuts cost and weight. To enable you to take full advantage of the economies of "thin wall" steel piping, Tube Turns offers a complete line of light weight fittings. TUBE-TURN* Light Weight Welding Fittings are produced under the same exacting quality control standards as the 12,000 other items in the Tube Turns' line. They are available promptly from your nearby Tube Turns' Distributor.

(*continued on next page*)

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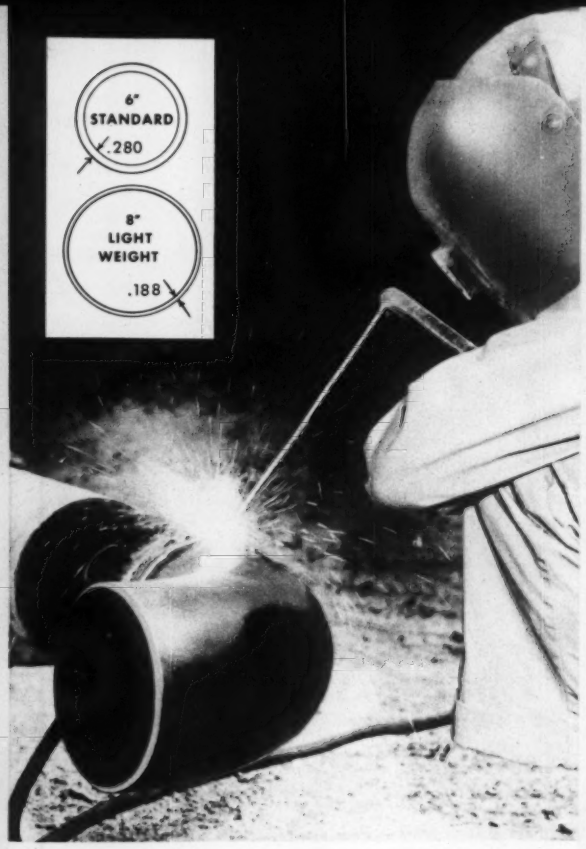
A DIVISION OF NATIONAL CYLINDER GAS COMPANY

Louisville 1, Kentucky

*"TUBE-TURN" and "tt" Reg. U. S. Pat. Off.



Available in nominal sizes from 4″ through 24″ . . . in wall thicknesses of .188, .219 and .250 inch. Also, 125 lb. light weight taper face welding neck flanges in sizes 2″—12″ inclusive.

How you can cut costs with

TUBE-TURN® LIGHT WEIGHT WELDING FITTINGS

A typical user of light weight steel piping reports these benefits: 100 feet of 8″ x .188″ wall pipe costs about $10 less than 100 feet of 6″ standard weight pipe • Increases flow area 85% • Cuts piping weight about 10% • To enable you to take full advantage of these economies, Tube Turns offers a complete line of light weight fittings. They are forged from seamless pipe. Meet all code requirements. Uniform wall thickness and true circularity permit field cutting of odd angles. Available promptly from Tube Turns' Distributors in all principal cities. Complete details in Bulletin TT 867, free on request.

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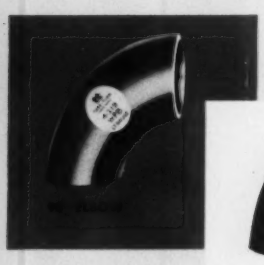
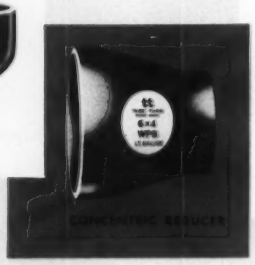


45° ELBOW

CAP



125 LB. W.O.G. TAPER FACE WELDING NECK FLANGE (PATENT PENDING)

Available from your nearby TUBE TURNS' Distributor

TUBE TURNS
224 East Broadway, Louisville 1, Kentucky

Please send free copy of Bulletin TT 867 on Light Weight Fittings and Bulletin TT 821 on Taper Face Flanges.

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Company Address _____

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Your Name _____

Position _____

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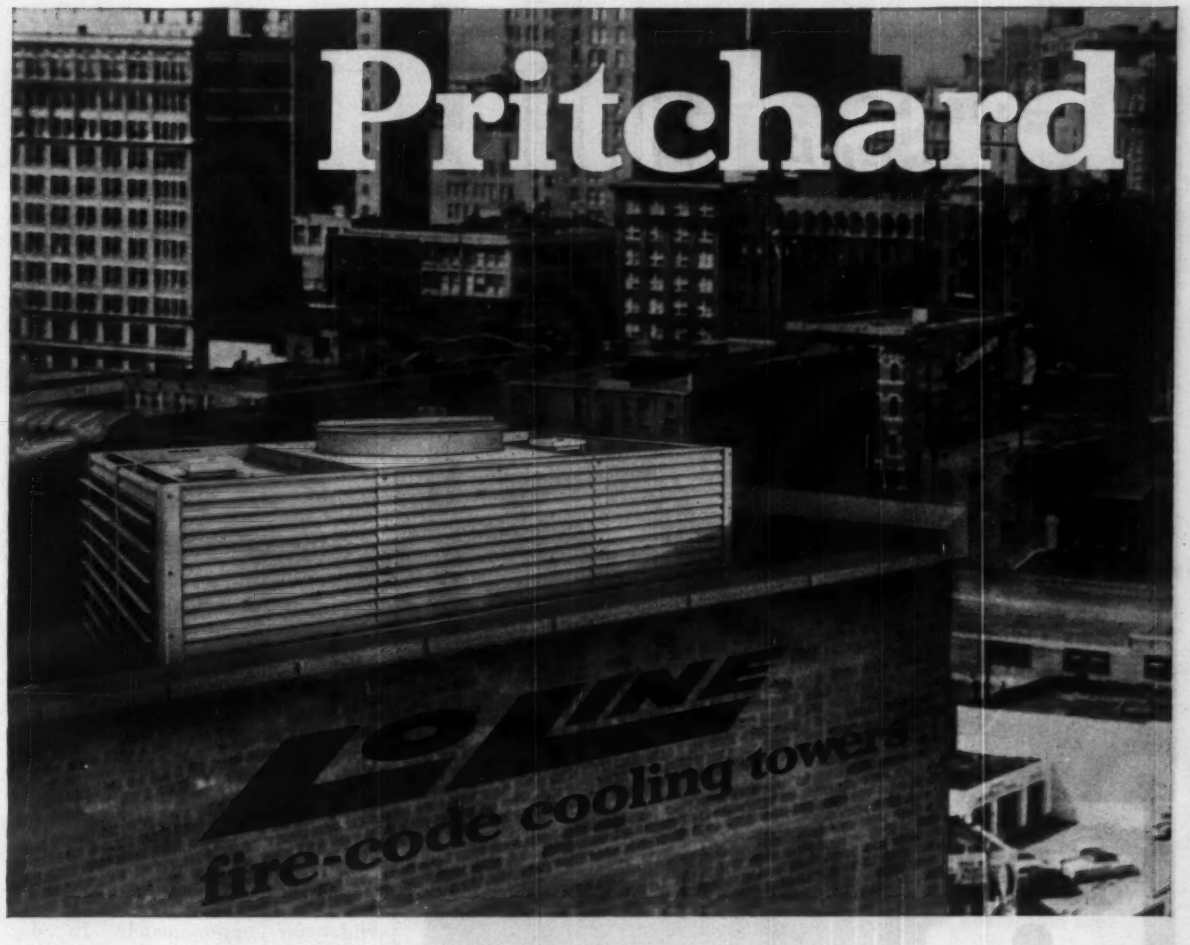

For metropolitan areas where attractiveness is desirable—and fire safety is essential

The new Pritchard LoLine cooling tower, companion to the Pritchard LoLine wood-framed tower, is specifically designed to conform to standard metropolitan fire codes. All structural members are steel. Louvers, casing, water distribution system and fan deck are asbestos cement. There simply is no combustible material exposed to the risk of fire.

But more than a fire-safe tower, this is a handsome cooling tower. Its low, sleek profile and uniform exterior treatment lift it out of the "necessary evil" class. It is well suited to installation where architectural considerations are important to the purchaser.

And it's a rugged tower. All steel parts are hot-dipped galvanized *after* fabrication for extra corrosion resistance. Heart quality California Redwood *only* is used for fill and drift eliminators to insure long, trouble-free life. Tough asbestos cement board exterior never needs painting. Tower maintenance is practically nil.

For full information on Pritchard LoLine Fire-Code Cooling Towers, mail coupon for Bulletin 5.2.902, which gives dimensions, mechanical details, specifications—the whole story. Or consult your nearby representative, whose name is listed in the Yellow Pages under "Towers."

J. F. PRITCHARD & CO. OF CALIFORNIA
Dept. 100, 4625 Roanoke Parkway, Kansas City 12, Mo.

- ☐ Send bulletin 5.2.902 on LoLine Fire-Code Towers
- ☐ Send bulletin 5.1.902 on Lo-Line Wood-Framed Towers
- ☐ Have your representative contact me

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Now stop corrosion, eliminate rusty water or contaminated contents before it starts by specifying Novelon lined hot water generators and storage tanks by Ellicott.
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formerly NOVELTY STEAM BOILER WORKS, INC.

EQUIPMENT DEVELOPMENTS

Continued from page 188

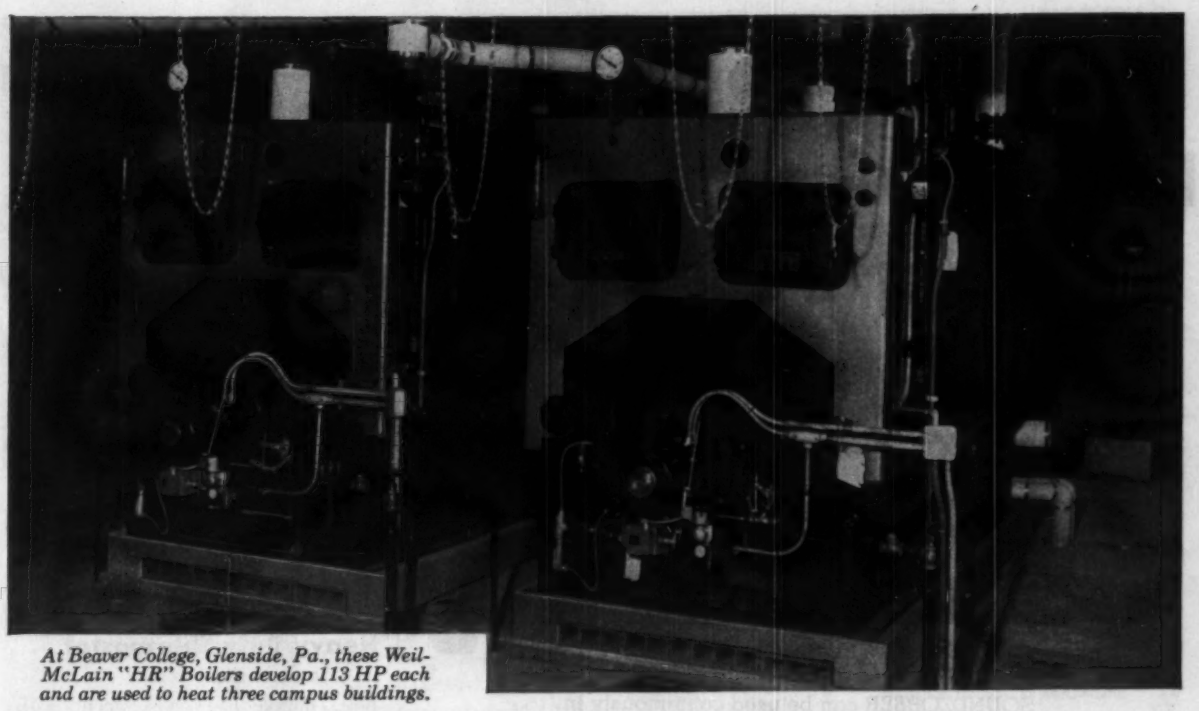
Temperature Control . . .

. . . with two separate switches, to permit switch action above or below set point, control of two independent circuits—*United Electric Controls Co., Dept. HPAC, 79 School St., Watertown, Mass.*

With micrometer type adjustment on "Type D70A", Fahrenheit or centigrade temperature settings made by rotating calibrated knob over graduated barrel. Switches adjusted individually by independent recessed hexhead screws, which provide for approximately 15 deg span. Thermal system consists of bulb, capillary, bellows filled with temperature sensitive liquid. Standard head compensation provided effective from −65 to 160 F. On-off differentials between approximately 1.0 and 2.0 F. Switches rated for 15 amps at 115 or 230 volts a-c.

Fume Scrubber . . .

. . . for removal of corrosive fumes of titanium pickling bath—*Heil Proc-*



At Beaver College, Glenside, Pa., these Weil-McLain "HR" Boilers develop 113 HP each and are used to heat three campus buildings.

Consulting Engineer: Ernest D'Ambly, Engineers Philadelphia, Pa.

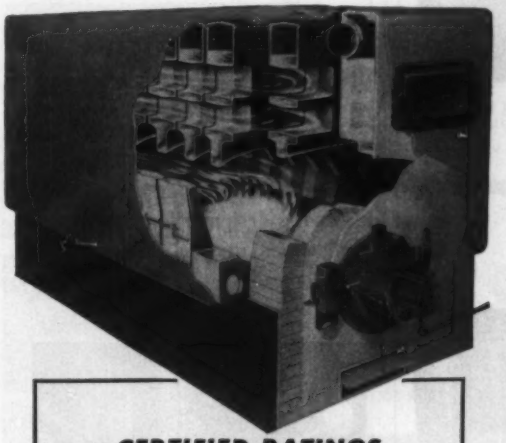
Contractor: Gray and Dormer, Philadelphia, Pa.

Distributor: J. D. Johnson, Camden, N. J.

Selected for
OUTSTANDING PERFORMANCE
ON LOW-COST HEAVY OIL

The selection of this pair of Weil-McLain "HR" Boilers as replacement units was dictated by their proved efficiency when equipped with horizontal rotary burners using heavy oil. Among the design features which assure the most favorable burning conditions and efficient heat absorption are:

1. Large firebox volume develops better combustion conditions and maximum radiant heat transmission.
2. Curved primary heating surface extends from crown sheet, greatly increasing area directly above the fire.
3. Balanced gas travel through the flueways assures equal distribution of heat to all secondary heating surfaces.
4. Generous waterways permit rapid, efficient water circulation through boiler.
5. Large steam space assures rapid generation of dry steam.
6. Rugged cast iron construction for durability and trouble-free operation.
7. Individual short draw rods simplify assembly and contribute to longer boiler life.
8. Steel front plate simplifies installation of rotary burner.
9. High base makes more combustion space available—eliminates high brick foundation.



CERTIFIED RATINGS

"Certified Ratings" are determined from a series of tests conducted with regularly listed I-B-R approved Weil-McLain 0-40 and 0-44 Heavy Duty Boilers. These tests were conducted in accordance with the provisions of the I-B-R Testing and Rating Code for Low Pressure Cast Iron Heating Boilers where special burners are used. A horizontal rotary burner was employed, using oil with a heat value of 150,000 BTU per gallon.

WEIL-McLAIN "HR"
HEAVY DUTY BOILERS FOR HORIZONTAL ROTARY OIL BURNERS

WEIL-McLAIN BOILERS · RADIATORS

WEIL-McLAIN COMPANY
MICHIGAN CITY, INDIANA

Address literature requests to Dept. AA-48

How to stop noise, vibration and "hammer" in water lines

THE ORIGINAL SOUNDZORBER expressly designed for use in air conditioning water lines . . .

A wire-reinforced wrapped fabric rubber pipe, SOUNDZORBER can be used continuously in water lines at up to 250 psi working pressure (safety factor: 5 to 1).

Smaller sizes ½" to 3" available with male I.P.T. bronze fittings. Larger sizes available with integral full-faced rubber flanges backed up with Series 15 or Series 30 steel flanges. No metal-to-metal contact.

SOUNDZORBER is but one of a complete line of Finn vibration controls. Finn has control devices for every vibration problem in your field. Write for complete information.

FINN VIBRATION FINNFLEX CONTROL

INDUSTRIAL DIVISION

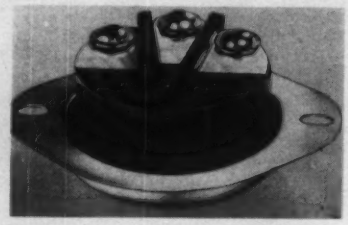
T. R. FINN & COMPANY, INC.
200 Central Ave., Hawthorne, N. J.

EQUIPMENT DEVELOPMENTS

Continued

ess Equipment Corp., Dept. HPAC, 12901 *Elmwood Ave., Cleveland.*

Scrubber is of packed tower type, steel constructed, lined with sheet plastic. For economy, scrubbing solution is recirculated, flowing counter to air being scrubbed, says company.



Heavy Duty Thermostat . .

. . . to meet requirements for single-pole, double-throw instrument with heavy duty electrical rating—*Spencer Thermostat Div., Metals & Controls Corp., Dept. HPAC,* 34 *Forest St., Attleboro, Mass.*

"Klixon 20500 Series" electrical rating is 30 amps, non-inductive, 120/240 volt a-c for standard life of 100,000 cycles on motor loads up to ½ hp. Maximum operating temperatures are 300 F for 100,000 cycles, 350 F for 6000 cycles. Fixed temperature settings from −10 F to 550 F. Models designed for large volume applications in electric heaters, fan motor controls.

Thread Protector Caps . . .

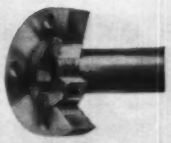
. . . designed to snap on, not come off unless unscrewed—*Precision Paper Tube Co., Dept. HPAC,* 2023 *Charleston St., Chicago* 47.

Metal staple snaps into, conforms to thread pattern. "Tecto-Cap" made from plastic coated kraft paper, protects against moisture, grease,

HERE'S 3 BIG REASONS WHY...

1. FLANGE WITHOUT WELDING

Faster than welding... *easier* than welding. A Speedline Insert Flange assures a leak-proof, *expanded* joint *every* time. Saves assembly time *and* costs!



Cutaway view shows pipe expanded into Insert Flange

2. LEAKPROOF UNION JOINTS

Speedline Unions are *gasket seated* to prevent leakage ... bi-metallic for easy make-up and disassembly without galling or seizing. Available in two types: PE for expanding or PW for welding to Sch. 5 or 10 pipe and Speedline Fittings.

Type PW—For Welding

3. EASIER, FASTER ALIGNMENT

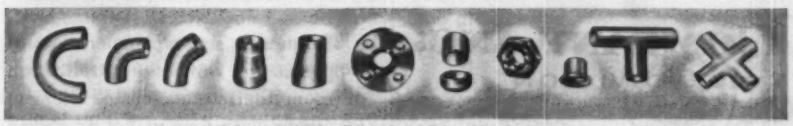
Speedline Aligning Connectors fit *over pipe ends* ... save time in aligning the most complex layout —permit preassembly *prior* to welding or brazing!

***PLUS* SPEEDLINE'S "EXTRA LENGTH" FEATURE**—There's an extra straight section on *every* end of *every* Speedline elbow, tee, reducer, bend and cross. This means extra clearance for welding and also facilitates joining with flanges or unions. Speedline Fittings, designed especially for use with Schedule 5 and 10 light wall stainless pipe, offer installation advantages and other cost savings not possible with conventional fittings. Write today for Speedline catalog or contact nearest Distributor.

810

Speedline STAINLESS STEEL FITTINGS

THE NEWEST THING IN PIPELINE ECONOMY



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Elizabeth, N. J.

SERVICE STEEL DIVISION VAN PELT CORP.
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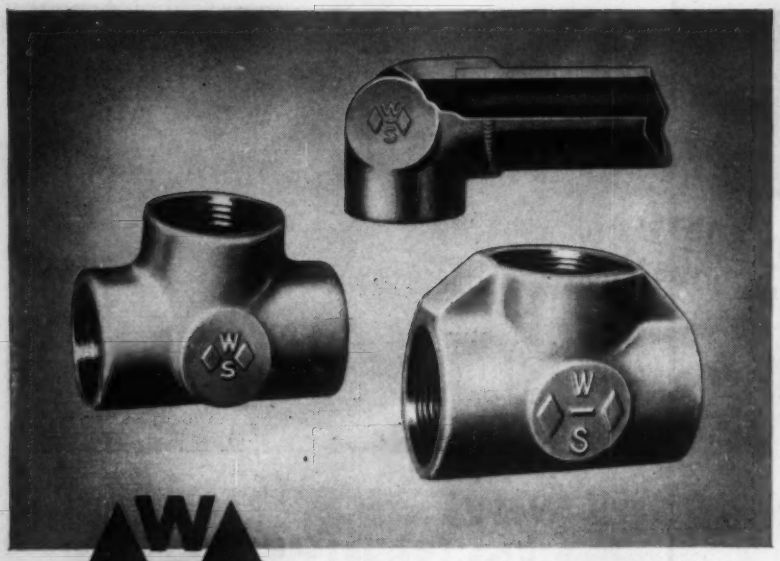


There's **extra** metal for **extra** strength in

W-S 150 lb. STAINLESS STEEL FITTINGS

Exceptional strength and perfect alignment are features you can rely on in W-S 150 lb. Stainless Steel Fittings. Because they resist corrosion, stand up to extreme heat and cold, they're ideal fittings to safeguard the processes of petroleum, chemical, food and other process industries.

Specify W-S screw-end and socket welding fittings. Available in sizes ⅛" to 4"...in every type you may need. Materials: Stainless Steel types 304 and 316. ASTM-A-182, Grade F-304, F-316 for forged fittings. ASTM-A-296, Grade CF-8, CF-8M for precision cast fittings.

Forge and Fittings Division manufactures a full line of high quality fittings, unions and couplets...in carbon, stainless and alloy steels. For information about them and for your commercial forging and die casting requirements, write to Forge and Fittings Division, H. K. Porter Company, Inc., Box 95, Roselle, N. J.

H. K. PORTER COMPANY, INC.

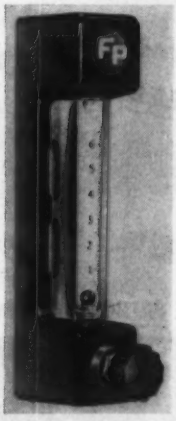
FORGE AND FITTINGS DIVISION

W-S Fittings Works, Roselle, N.J. • Cleveland Forge Works, Cleveland 4, Ohio
Stainless Steel Works, Duncannon, Pa. • Cleveland Die Cast Works, Cleveland 4, Ohio

EQUIPMENT DEVELOPMENTS

Continued

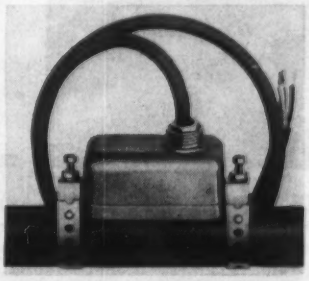
chemicals, other conditions causing corrosion or rust. Furnished with open or closed ends in standard diameters to fit all pipe, rod sizes to 1 in.



Purge Meter . . .

. . . for purging gases in lines features removable "snap-in" tube, removable end fittings—*Fischer & Porter Co., Dept. HPAC, 578 Jacksonville Rd., Hatboro, Pa.*

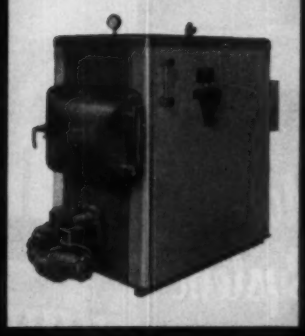
Fittings and tube for this unit can be removed, replaced in seconds without use of tools, according to manufacturer. Additional features cited: corrosionproof glass fiber body, 3 in. scale length, white backing on tube for visibility, snap-on protective plastic shield.



Changeover Thermostat

. . . designed for use on combination heating, cooling air conditioning units—*Barber-Colman Co., Dept. HPAC, 1300 Rock St., Rockford, Ill.*

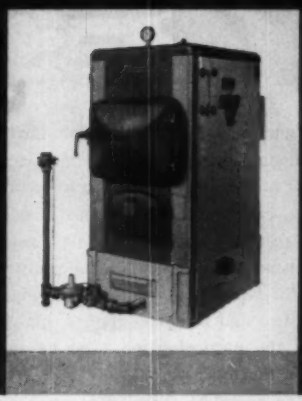
Thermostat senses temperature of supply media, reverses control action of room thermostat sensing element to comply with flow of hot or chilled



Oil-fired units are equipped with a Kewanee pressure atomizing burner for No. 1 or No. 2 oil. Firing rate is matched to boiler capacity. Burner and controls are shipped in separate, protective cartons, ready for wiring. Insulated metal jacket shown is optional.

new packages!

15 lb steam or 30 lb water
216,000 to 1,800,000 Btuh



Gas-fired units feature Kewanee's atmospheric type drilled port gas burner for natural, mixed, manufactured or L.P. gases. Firing is automatic . . . matched to boiler capacity. Burner and controls are shipped in separate, protective cartons . . . installation is easy.

KEWANEE® SQUARE-HEAT TYPE "R" BOILER-BURNER UNITS

All 12 sizes of one of the best-known, best-*proven* boilers for domestic and commercial heating are now available with matching burners for gas or oil.

Ideal for service in small to medium buildings and larger homes, Kewanee Square-Heat Type "R" Units are quiet, efficient and dependable. Their record is established, you *know* what to expect from them.

Even the largest sizes take little floor space and fit easily under an 8-foot or even a 7-foot ceiling. All the famous Kewanee features are there: 3" fire tubes expanded into tube sheet holes with ends beaded . . . large firebox for complete combustion . . . cast iron flue door, machine ground and refractory insulated . . . widely spaced tubes, large disengaging area and ample steam space.

See your Kewanee Man for further facts . . . or send coupon at right to: AMERICAN-STANDARD, KEWANEE BOILER DIVISION, 115 Franklin Street, Kewanee, Illinois.

American-Standard
Kewanee Boiler Division
115 Franklin Street, Kewanee, Ill.

KEWANEE 1858 1958 90th year

Please send descriptive literature and catalog sheets on the new Kewanee Square-Heat Type "R" packaged units.

Name_____

Firm_____

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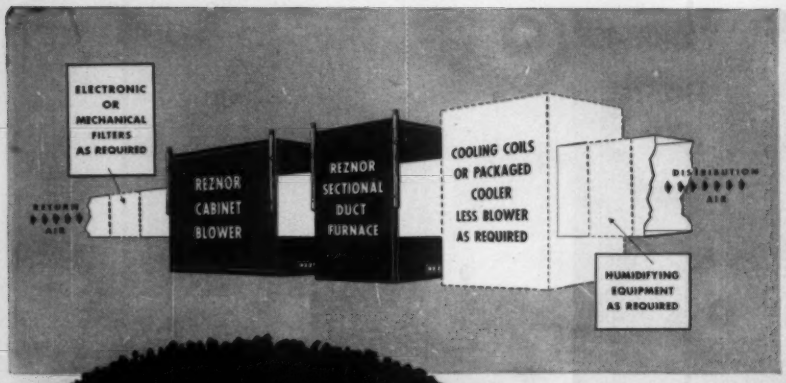
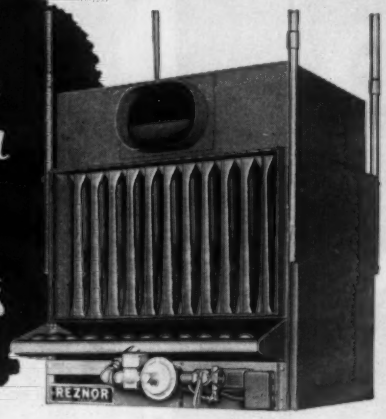
KEWANEE BOILER DIVISION


ELECTRONIC OR MECHANICAL FILTERS AS REQUIRED
REZNOR CABINET BLOWER
REZNOR SECTIONAL DUCT FURNACE
COOLING COILS OR PACKAGED COOLER LESS BLOWER AS REQUIRED
HUMIDIFYING EQUIPMENT AS REQUIRED

How to Match a Heating System to Exact Job Requirements



Reznor sectional duct furnaces free the designer from the limitations imposed by packaged heating equipment . . . equipment which can't be *exactly right* for any one job because it has to be *good enough* for so many different jobs.

A heating or heating-cooling system designed around a Reznor duct furnace can be matched to exact job requirements. Each duct furnace is a compact, highly efficient heat exchanger with a full set of operating controls. All other components,—for air moving, cooling, cleaning and moisture control—are separately specified and installer-supplied. Only those components which are necessary on the particular job need be included, with each individually selected to fit that one job.

Sectional assembly (a completely new concept in duct heating equipment) completely eliminates the installation problems which formerly prevented the use of large capacity custom-engineered duct heating systems. With the Reznor Series DS sectional duct furnace, systems with capacities in excess of 2,000,000 Btu can be assembled on the job from sections weighing no more than 315 pounds. Each of four basic sections—150, 200, 250, and 300 thousand Btu—is complete with controls and is provided with its own built-in draft diverter, flue connections and mounting pipes.

If you aren't taking advantage of the design flexibility of Reznor sectional duct furnaces, you're missing a good bet on many of your commercial, industrial and institutional jobs. Don't delay getting all the details on this versatile line of heaters. Give your nearby Reznor distributor a call—today.

REZNOR
WORLD'S LARGEST-SELLING DIRECT-FIRED UNIT HEATERS
Reznor Manufacturing Co.,
51 Union St., Mercer, Pa.

for complete details,
wherever you are . . .
Look for Reznor under "Heaters-Unit" in the Yellow Pages

EQUIPMENT DEVELOPMENTS

Continued

water. Applications in process control also possible. Switch action is single-pole, double-throw snap-acting. Nonadjustable control point setting is 70 F, with fixed differential of approximately 15 F. Factory sealed to prevent condensation from forming on contacts.

Arc Welder . . .

. . . of a-c transformer type, with deverted path design—*Hobart Brothers Co., Dept. HPAC, Hobart Sq., Troy, Ohio.*

Control for adjustment of welding provides five steps of coarse settings, with rheostat for fine adjustment in each range. Extra secondary winding supplies current to control selenium rectifier, 35 volts d-c. "Model TD-316-S" rated 300 amps at 40 volts a-c, with welding range of 35 to 375 amps. "Model TD-416-S" rated 400 amps at 40 volts a-c, with welding range of 35 to 500 amps. "Model TD-516-S" rated 500 amps at 40 volts, with welding range of 35 to 625 amps.

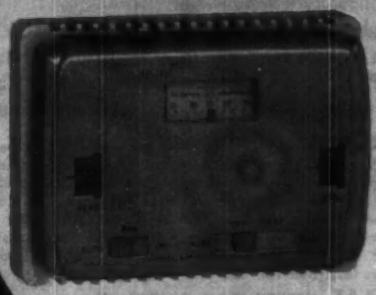
Plastic Pipe Cement . . .

. . . developed for permanent bonding of rigid polyvinyl chloride pipe sections, fittings—*Schwartz Chemical Co., Dept. HPAC,* 326-328 *W. 70th St., New York* 23.

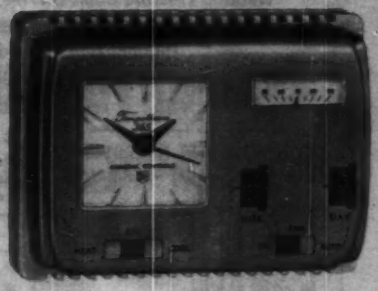
Bonding agent formulated from pure, unmodified polyvinyl chloride; cemented joint is as resistant as pipe itself, says company. Viscous cement is applied by brush, can also be used in fitting loose joints. Drying rate is

Set Him FREE!

Give your heating and air conditioning systems engineer a break. Let him know GENERAL CONTROLS has the answer to COMPLETE DESIGN FREEDOM with air conditioning thermostats for ANY system – gas, oil, coal, electric refrigeration, evaporative, chilled water and heat pump. With GENERAL CONTROLS thermostats he'll have a choice of 118 functional variations for control of any system...automatically...reliably! Worth time and ideas to him...money saved in engineering time to you.



YEAR-ROUND AIR CONDITIONING (Model T-240G) *Flexible, manual and automatic, single unit change-over, two-stage heating, two-stage cooling.*



TEMPOTHERM "365" . . . (Model T-271) *Electric clock day-nite air conditioning thermostat. Night temperature control improves humidity, provides cooling storage effect.*

VERSATILITY UNLIMITED!

Cool, heat, fan, auto, off, reset switching functions • Heating or Cooling – dual or single stage • Heat-Cold anticipation Day-Night Clock programming • Single or Dual Dial temperature selection • Manual or Automatic change-over.

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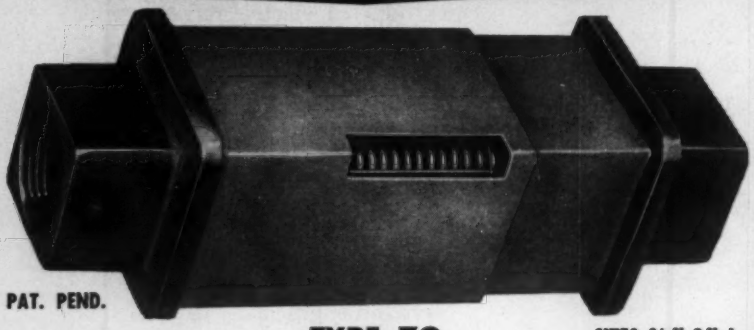
Keflex QUADRA-SIDE

Telescopic Expansion Compensators

WITH LAMINATED STAINLESS STEEL BELLOWS, 2 PLY OR MORE

. . . *something new for the* ARCHITECT — ENGINEER — CONTRACTOR

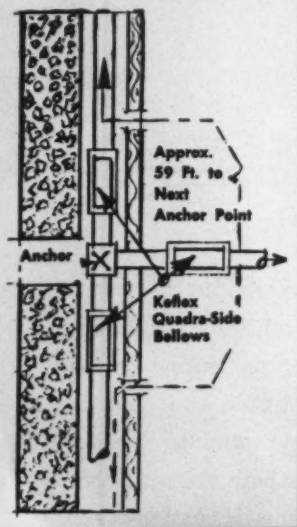


PAT. PEND.

TYPE 7Q SIZES ¾"-3" Inc.

Working Pressure 300 P.S.I. — Temperature to 800°F. — Has Reserve Strength — Not Just Borderline Prospect of Withstanding Effect of Pressure — Shock — Thermal Line Expansion — High Temperature — Moderate Vibration. HIDDEN PROTECTION PLUS! All Non Corrosive Stainless Steel Bellows With Brass or Bronze End Fittings and Telescopic Shrouds.

KEFLEX FITS IN NARROWEST WALL SPACE—SAFE—PERMANENT



● **ROUND** KEFLEX Bellows are made of Laminated Stainless Steel, multiple ply (usually 2 ply or more) for greater strength with minimum force required to move bellows. The minimum force to move 7 Q Keflex Bellows greatly reduces the need for additional anchoring above that required to handle line pressure thrust force as the force to move Keflex 7 Q only is always less than 100 lbs.

● **FLAT** KEFLEX FLAT GUIDES offer so many advantages it is difficult to mention them all. Briefly: The KEFLEX FLAT OUTSIDE GUIDE (shroud) is made of brass USUALLY formed square of required length —one unit end will telescope over other unit end. The flat surfaces slide over and in one another—practically eliminating possibility of torque as result of faulty installation. This ASSISTS PROPER GUIDING.

● **SQUARE** KEFLEX SQUARE END FITTINGS are made of heavy, non-porous, square, bronze stock, and threaded tapered female pipe size. They are attached to the KEFLEX 7 Q bellows and the outside guides by silver brazing. The result is an easy moving expansion joint that will absorb either the slightest or the greatest thermal pipe expansion and with practically no load on the anchors. The heavy bronze ends, which will not crush during normal installations, assures safe and leakproof joints.

▶▶▶ WRITE TODAY FOR LITERATURE

U. S. FLEXIBLE METALLIC TUBING CO.

SINCE 1905

KEFLEX MANUFACTURING DIVISION

454 EAST THIRD STREET, LOS ANGELES 13, CALIFORNIA

SAN FRANCISCO 5 63 MAIN ST. | PORTLAND 9, OREGON 328 N.W. BROADWAY | SEATTLE 4, WASHINGTON 2425—6TH AVE. S.

EQUIPMENT DEVELOPMENTS

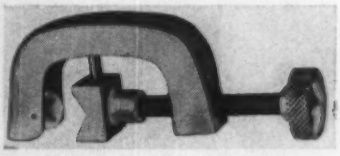
Continued

said to be slow enough to allow use on large diameter pipe, fittings. Resistant to acids, alkalies, water, gasoline, oils. Recommended for underground as well as exposed installations.

Blower Wheels . . .

. . . interchangeable with existing wheels and assemblies—*Morrison Products, Inc., Dept. HPAC,* 16816 *Waterloo Rd., Cleveland* 10.

Wheels are 15 in. diam, range from 6 to 16 in. width, deliver air up to 4800 cfm. "Series 150" wheels have standard bores of ¾, 1, 1 3/16 in. Made of cold rolled steel, processed through multistage wash, phosphotizing wheels for painting in epon resin finish. Also available made from continuous strip galvanized steel for special air conditioning applications.



Tube Cutter . . .

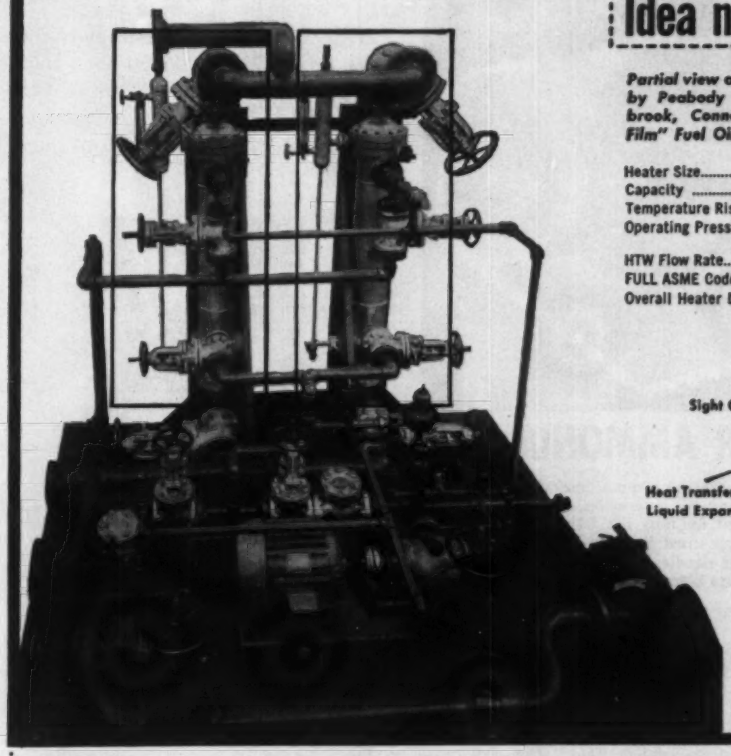
. . . especially made to cut copper, brass, aluminum, plastic tubing—*Miller Mfg. Co., Dept. HPAC,* 251 *W. Kellog Blvd., St. Paul* 2.

"Little Giant" tool has capacity to handle tubing ⅛ to ⅝ in. Head block aligns tubing, so cutting wheel is at right angles, cuts without distortion, with minimum burr, says company.

Flow Recorder . . .

. . . receives, records output from four remote ring balance meter operated slide wires—*Hagan Chemicals & Controls, Inc., Dept. HPAC,* 323 *Fourth Ave., Pittsburgh* 30.

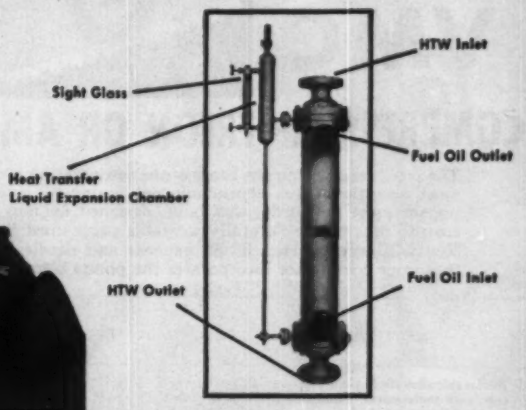
Instrument records fluid density, liquid level in open or closed vessels, boiler drum water levels, temperature and pressure compensated fluid flow readings, others at an overall accuracy of 0.5 percent of full scale. Available as a-c bridge, d-c potentiometer,



Idea no. 2 from Paracoil

Partial view of pump and heater set fabricated by Peabody Engineering Corporation, Glenbrook, Connecticut, utilizing two "Thermo-Film" Fuel Oil Heaters of these specifications:

Heater Size	FF-48 HTW "Thermo-Film"
Capacity	7500 lbs. No. 6 oil per hour
Temperature Rise	80°F to 210°F
Operating Pressures	300 psi, water side 315 psi, oil side
HTW Flow Rate	100 GPM at 370°F
FULL ASME Code Construction	
Overall Heater Dimensions	15" x 6'-6"



How to use High Temperature Water directly in a #6 oil heater...without danger of system contamination!

The Problem

The pre-heating of #6 fuel oil with High Temperature Water to provide adequate oil temperature and eliminate possibility of leakage of fuel oil into the HTW stream.

Leakage of fuel oil into the HTW stream would result in contamination of the system and could cause serious and costly damage to the boiler and the entire system.

The isolation of the fuel oil heaters can be accomplished by several methods. For example, the HTW stream may be passed through an evaporator to supply steam for use in a steam-type fuel oil heater. Or, the HTW stream may be passed through an intermediate water-to-water exchanger to heat a secondary water stream circulated through a water-type fuel oil heater.

In both of these systems, the HTW stream is safely isolated from the fuel oil heater by an intermediate secondary circuit. But effective as these methods are, they both require a minimum of two heat exchangers, additional space and additional connecting piping, regulators, level controls, etc.

A New Solution

Now for the first time the Paracoil "Thermo-Film" Fuel Oil Heater furnishes the optimum solution to the problem. **In a single exchanger** the "Thermo-Film" Heater provides adequate oil temperature, isolation of the HTW circuit from the oil circuit, a reduction in space requirements, simplicity of operation and substantially lower initial installation cost. A number of double tube elements are enclosed within the heater shell providing three circuits: the primary HTW circuit, an intermediate heat transfer fluid circuit, and the oil circuit.

The heat flow path is from the HTW to the heat transfer fluid to the fuel oil. In the rare event of an oil tube failure, the free oil cannot contaminate the HTW stream as it becomes trapped in the intermediate space containing the heat transfer liquid, and gives warning to the operating personnel by rising in the indicating gauge glass at the expansion chamber.

Your inquiries for Paracoil "Thermo-Film" applications to HTW systems are invited.

CUT ALONG DOTTED LINE AND SAVE

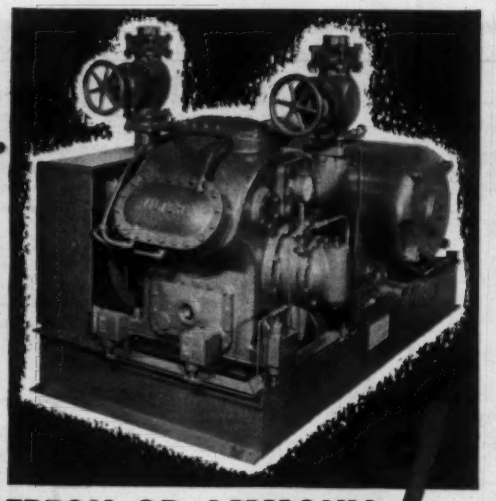
DAVIS ENGINEERING CORPORATION

30 Rockefeller Plaza, New York 20, New York • Circle 6-5650

Before deciding...

compare the

Vilter VMC



COMPRESSOR—FREON OR AMMONIA!

The compressor being the heart of the refrigeration system deserves the most attention. For dependable day-in-day-out operation, the compressor must be sturdy, well built, designed for long life. It must be easy to maintain. Naturally wearable parts must be easy to replace. You will save yourself future expense and needless worry if you see that your compressor incorporates the points below.

CHECK THESE POINTS	VILTER	5 OTHER WELL-KNOWN MAKES				
		A	B	C	D	E
1. Removable alloy steel cylinder sleeves that permit low cost, easy replacement. Eliminates need for oversize pistons, rings, etc., which are common in frame bored cylinders	Yes	Yes	No	No	Yes	Yes
2. A double bellows oil immersed shaft seal that prevents air or moisture from entering the system when operating below atmospheric pressure	Yes	No	No	No	No	No
3. A crankshaft double row roller bearing arrangement that allows the shaft to expand freely, thus preventing excessive thrust loads on the bearings	Yes	No	No	No	No	No
4. A statically and dynamically balanced crankshaft that assures smooth operation	Yes	Yes	Yes	Yes	—	Yes
5. Spring loaded safety heads that protect the compressor against refrigerant slugs	Yes	No	Yes	No	No	Yes
6. Removable connecting rod bearings that can be changed without also removing the connecting rod and piston assembly	Yes	No	Yes	Yes	Yes	Yes
7. Necessary to dismantle entire unit for repairs	No	No	Yes	Yes	No	No
8. Suitable for high stage or booster operation	Yes	Yes	No	No	Yes	Yes
9. Light weight aluminum pistons with upper half of piston wall having tapered thickness to conduct heat from top of piston. This prevents excessive piston expansion and reduces possibility of piston seizure	Yes	No	No	Yes	No	No
10. A separate oil filter, in addition to crankcase screen, to super-clean oil and thus reduce wear to a minimum	Yes	Yes	No	Yes	Yes	Yes

From this comparison, you know that *you get more for your money* with Vilter. It will pay you to consider Vilter for your next refrigeration or air conditioning installation.

Vilter®

REFRIGERATION and AIR CONDITIONING

WRITE for your FREE Vilter Bulletins: No. 817—"Vilter VMC Ammonia Compressors"—and No. 820—"Vilter VMC Freon Compressors"—to THE VILTER MANUFACTURING CO. Dept. F-719, 2217 South First Street Milwaukee 7, Wisconsin

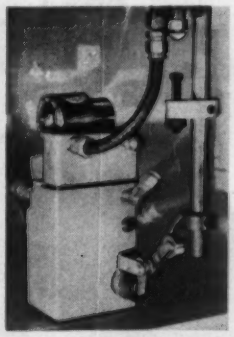
THE VILTER MANUFACTURING COMPANY, Milwaukee 7, Wisconsin

Air Units • Ammonia & Freon Compressors • Booster Compressors • Baudelot Coolers • Water & Brine Coolers • Blast Freezers • Evaporative & Shell & Tube Condensers • Pipe Coils • Valves & Fittings • Pakice & Polarflake Ice Machines

EQUIPMENT DEVELOPMENTS

Continued

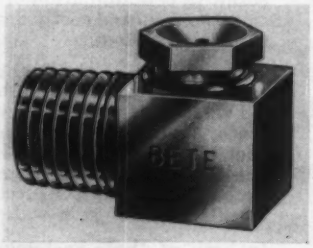
or d-c voltmeter; where distances do not exceed 2000 ft or 20 ohms total line resistance, receiver can be furnished with a-c servo operated bridge; for greater distances, d-c potentiometer is used.



Four-Way Valve . . .

. . . to actuate pneumatic equipment —*Dixon Automatic Tool, Inc., Dept. HPAC,* 2300-23*rd Ave., Rockford, Ill.*

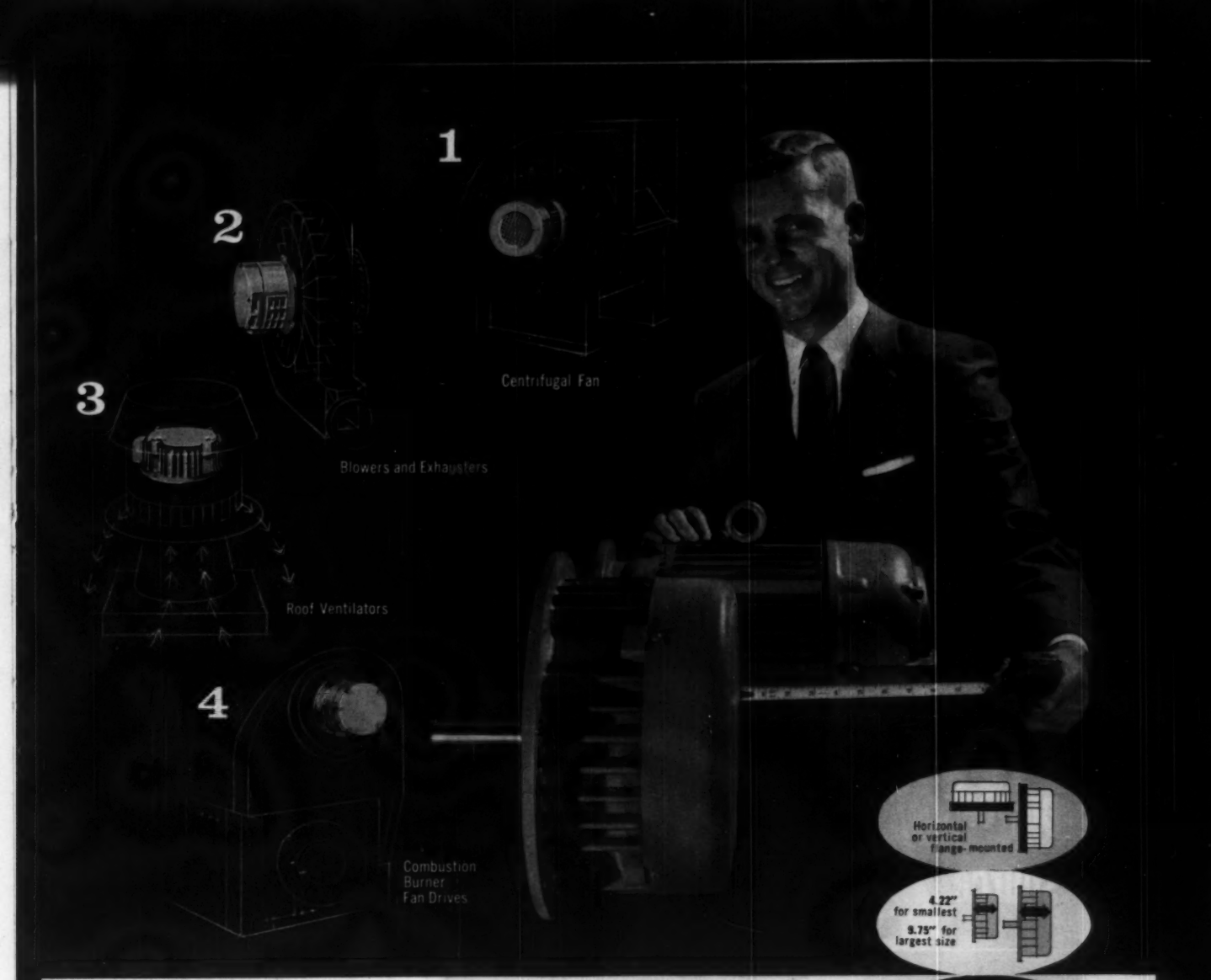
"Control Pac" may be used to obtain reciprocating action of double acting cylinders with either long or short stroke; can control more than one mechanism and is used to control parts escapement, positioning action in high output assembly operations, company says. New unit includes pilot operated slide valve, remote return control throttling valve, electrical junction box with provision for air silencer, either electric or pneumatic initiation. Dimensions are $3 \times 2 \times 6\frac{7}{8}$ in. including solenoid pilot valve.



Whirl Nozzles . . .

. . . in new series added to manufacturer's line — *Bete Fog Nozzle, Inc., Dept. HPAC, Greenfield, Mass.*

New "WT series" nozzles atomize liquid through "tangential whirl chamber" principle. Nozzles have hollow cone spray patterns of 80 deg.



New Pancake motor is up to 60% shorter — saves space on fans or blowers

Louis Allis Pancake Motor offers many advantages for use in air-moving equipment

The Louis Allis Pancake Motor offers substantial savings in space, weight and installation cost when used for powering fans, blowers and ventilators.

It is an extra short length flange-mounted motor that saves space by hugging the contour of the fan housing. It is up to 60% shorter and 33% lighter than standard motors — blends into the housing, doesn't protrude, keeps overhanging weight and moment-arm low. And there's a decided saving in space over foot-mounted motors that require a special base or right-angle pedestal for mounting.

This new motor has conventional radial air gap construction, assuring excellent torque characteristics and performance.

Housing and flange are one piece, which permits accurate internal machining. This, plus the use of large pre-lubricated bearings, greatly extends bearing life and reduces noise level.

Sized from ¾ to 15 hp; 3600, 1800, 1200, and 900 rpm; open drip-proof and enclosed non-ventilated and fan-cooled enclosures. For more information, contact your local Louis Allis District Office, or write for Bulletins 2100 and 2150 to The Louis Allis Co., 453 East Stewart Street, Milwaukee 1, Wisconsin.

LOUIS ALLIS

SM-111

MANUFACTURER OF ELECTRIC MOTORS AND ADJUSTABLE SPEED DRIVES

only WAGENER

GIVES YOU "CUSTOMIZED" PUMPS FROM STOCK COMPONENTS!

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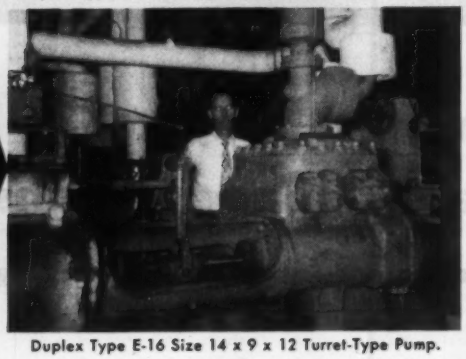
for every job

Duplex Type FO, Size 2½ x 1½ x 3 Pump.

any power source

Simplex Type SP, Size 3½ x 5 Side Pot Pump.

with dependable performance



Duplex Type E-16 Size 14 x 9 x 12 Turret-Type Pump.

Powered by CO_2 for operating boom of carbon dioxide Fire or Crash Truck made by a well known Chicago manufacturer (top) . . . by diesel engine for pumping grout on construction job in Spain (center) . . . by steam for boiler feeding at Veterans Soldiers home in Los Angeles (bottom) . . . **Wagener pumps are readily adapted to available power sources including electricity and compressed air.** Divided piston rods enable us to assemble Wagener pumps from standard parts to individual specifications for power and liquid ends. Costs are reduced. Maintenance is easier. Most replacement parts are shipped within 24-hours. For complete information about Wagener versatility and dependability for pumping anything that will flow, write today.

WAGENER PUMPS

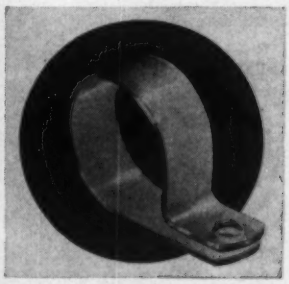
WAGENER PUMP DIVISION
Canton Stoker Corporation
2400 Andrew Place S. W. • Canton 1, Ohio

CANTON STOKERS

EQUIPMENT DEVELOPMENTS

Continued

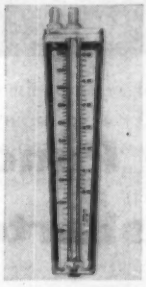
Available in five standard models with flow rates from 0.1 to ½ gpm at 40 psi; special models with narrower spray angles available. In stock in brass; made to order in plastic, other free machining materials, manufacturer says.



Tubing Clamps . . .

. . .made of synthetic product fabric resin—*Richco Plastic Co., Dept. HPAC, 4445 W. Fullerton Ave., Chicago* 39.

Clamps recommended by manufacturer for temperatures as low as −60 F, as high as 300 F. New line comprises 13 sizes from ⅛ to 1 in. ID. Clamps are ⅜ in. wide in sizes up to ½ and 9/16 in. wide thereafter.



Air Velocity Meter . . .

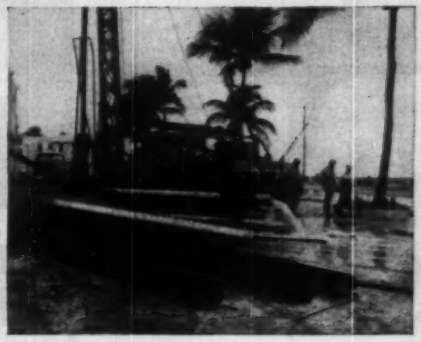
. . . developed to give direct readings for furnace draft, pressure drop across air filters, duct air velocity, supply register velocity, return grille velocity—*F. W. Dwyer Mfg. Co., Dept. HPAC, P. O. Box* 373, *Michigan City, Ind.*

Based on principle of variable area flowmeter, "No. 460 Air Meter" has one moving part, registers air velocity in two ranges—260 to 1200 fpm low and 1000 to 4000 fpm high. Static pressure is 0.0005 to 0.09 in. low range and 0.05 to 1.0 in. high.

(*Continued on page* 207)

Another new development using

B.F.Goodrich Chemical *raw materials*



Corroded steel pipes pulled from well at Hollywood Beach Hotel, Miami, Florida.

Vinyl pipes in 4, 6, and 8-inch diameters are used for drop pipes. Photo shows pipe in well casing.

SO THEY REPLACED THE CORRODED PIPE

WITH GEON RIGID VINYL

DEEP wells are often used to provide cooling water for refrigeration systems. In the Miami, Florida, area wells supply salt water—fine for cooling but rough on steel drop pipes that in many cases have corroded and failed in less than 18 months.

Now rigid vinyl pipe made of Geon polyvinyl materials is used for the drop pipe which slips inside a driven steel casing. This vinyl pipe is unaffected by salt water, as well as galvanic corrosion. A built-up plastic O-ring at the bottom of each drop pipe seals the pipe within the casing.

Geon vinyl pipe makes a big hit with installation crews too. It's lightweight and easy to handle. As the pipes are lowered into the casing, they are readily assembled with a coupling by solvent welding into a continuous length that may extend to a depth of 200 feet.

In any piping system where you have a corrosion problem, consider rigid vinyl pipe made of Geon. For informative booklet write Dept. LW-2, B. F. Goodrich Chemical Company, 3135 Euclid Avenue, Cleveland 15, Ohio. Cable address: Goodchemco. In Canada: Kitchener, Ontario.

B. F. Goodrich Chemical Company
a division of The B. F. Goodrich Company

B.F.Goodrich GEON polyvinyl materials • HYCAR American rubber and latex • GOOD-RITE chemicals and plasticizers • HARMON colors

FOR HIGHEST ACCURACY AND SENSITIVITY USE...

HASTINGS
AIR VELOCITY MEASURING INSTRUMENTS

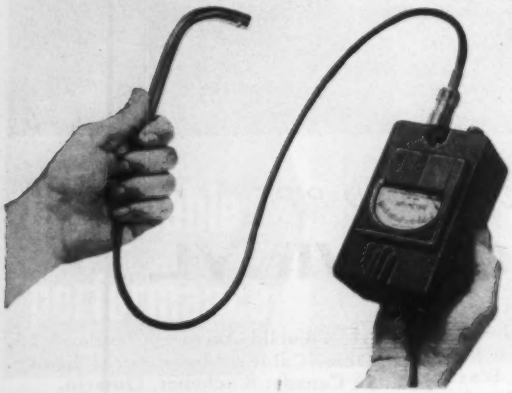
MODELS COVER RANGES FROM 0 TO 200 M.P.H.

Hastings Jet-Vane is a rugged air velocity vane of solid cast aluminum for rooftop or tower installations. Range: 3-200 mph. Used with indicators or recorders.

DIRECT, INSTANTANEOUS READINGS . . .
UNAFFECTED BY TEMPERATURE VARIATIONS . . .
IDEAL FOR REMOTE INDICATION OR RECORDING.

Write Today for Complete Catalog Information

Hastings Horizontally Non-Directional Probe for accurately measuring extremely low range air velocities. Range: 0-30 mph. Expanded scale below 5 mph.



Hastings Model G Air-Meter. Velocity range: 0-6000 fpm. May be used ideally in usually inaccessible areas.

Hastings Model B Precision Air-Meter for measurements of highest accuracy. Dual-scale meter with range up to 20,000 fpm. Directional or non-directional probes.

HASTINGS-RAYDIST INCORPORATED
Hampton 34, Virginia

Manufacturers of Hastings Vacuum, Pressure, Velocity and Flow Measuring Instruments
Raydist Electronic Surveying, Tracking, Positioning and Navigation Systems

EQUIPMENT DEVELOPMENTS

Continued from page 207

Aluminum Welding . . .

. . . with three inert gas welding techniques—*Kaiser Aluminum & Chemical Corp., Dept. HPAC, 1924 Broadway, Oakland 12, Calif.*

"Qualiweld" developed to reduce porosity, dross. Inert gas welding gun is modified so mixture of argon, chlorine can be introduced down contact tube directly into inner core of arc, eliminate effects of contaminants. "Econoweld" technique adapted to low cost welding of bus bar, other low alloy aluminum sections. Nitrogen replaces inert gas in shielding atmosphere, low flow inert gas used in contact tube. "Chlorecon" technique employs low flow of inert gas containing small amount of chlorine down contact tube with low flow inert gas through nozzle in outer shield.

Air Purification Unit . . .

. . . in self-contained model designed for flush mounted fitting in wall—*Barnebey-Cheney Co., Dept. HPAC, Cassady at Eighth, Columbus 19, Ohio.*

Wall purifier consists essentially of series arrangement of dust filter, activated charcoal adsorber cell, exhaust fan housed in cabinet with louvered cover plate. Fan pulls stale or impure air through dust filter, then through adsorber cell, returns cleaned, odorless air to room, says company. Contaminating impurities, odors are trapped, adsorbed in passages of activated charcoal particles.

Engineers across the country are specifying

Flexon®

PACKLESS EXPANSION COMPENSATORS

All over the country, for the finest, most modern buildings, you'll find Expansion Compensators written into the heating specifications. Why? Simply because there's no substitute for their completely packless design, their easy installation, and the fact that they *never need maintenance!*

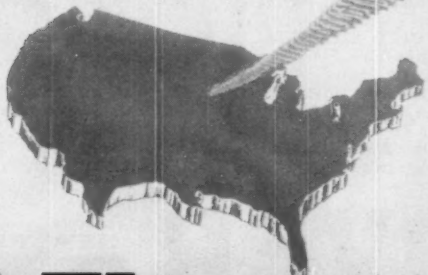
Yes, there's no easier or lower-cost way to take care of pipe and tubing expansion and eliminate water hammer noise, especially in baseboard convector installations. Installed in minutes; you can forget it for the life of the building.

Flexon Packless Expansion Compensators are the modern, low-cost way to absorb pipe motion, proved in thousands of installations. Why not write them into your next job? Write today for the cost data, and the name of your Flexon distributor.

The inside story

2-PLY CONSTRUCTION

The bellows is fabricated from two plies of specially-rolled metal to combine strength with flexibility. Bronze bellows for Model L; stainless steel for Model H.



Send for the complete Flexon Design Guide

Everything you need to know about absorbing pipe motion, in a concise 28-page design guide.

EC-115

Flexonics corporation

EXPANSION JOINT DIVISION • 1391 S. THIRD AVENUE, MAYWOOD, ILLINOIS

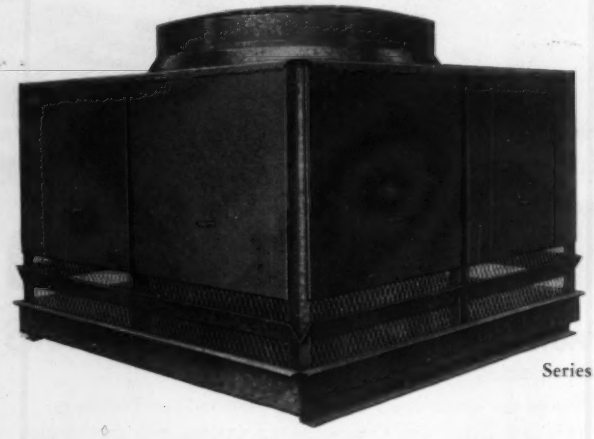
EXPANSION JOINTS · METAL HOSE · NON-METALLIC HOSE · BELLOWS · AIRCRAFT COMPONENTS

Introducing the **DOVER**

silLOWette

COOLING TOWER

(5 to 150 ton capacities)



Series R

The Boldest Advance in Cooling Tower Design in Years!

BOLD New Appearance!

LOW SILHOUETTE . . . The Dover silLOWette is designed to hug the roof line in any installation . . . the type of design architects are demanding.
COLOR . . . That's right . . . *color!* For the first time, real BEAUTY in a cooling tower with white transite or colored plastic side panels. Available in a wide range of colors.
LIGHTING . . . Translucent panels permit interior lighting of silLOWette tower for attractive display purposes.
GALVANIZED STEEL . . . All steel parts of the silLOWette tower are hot dip galvanized *after* fabrication to prevent rust and corrosion. Assures attractive appearance plus years of service.

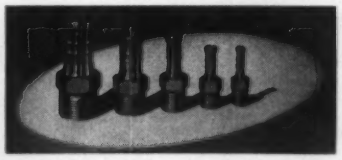
Bold NEW Features!

REMOVABLE SIDE PANELS . . . Just flip side panels up-and-out, and tower interior is completely accessible! No bolts, no screws!
AIR COOLED BEARINGS . . . Unique bearing arrangement gives longer life from bearings with less maintenance. External grease fittings make lubrication easy.
ALL PURPOSE UTILITY SUMP . . . Flushing and cleaning tower basin is fast and easy with Dover's exclusive new right angle sump.
FLANGE – ASSEMBLED CELLS . . . Towers larger than 150 ton capacities can be set-up easily and quickly at job site.

DOVER
MANUFACTURING COMPANY
Dept. 100, 3117 Weatherford Avenue
Independence, Missouri

NEW, FREE FOLDER
Send today for your copy of the new Series R silLOWette folder. It's full of details, specifications and drawings of the New Dover silLOWette tower.

EQUIPMENT DEVELOPMENTS
Continued



Hose Nipples . . .

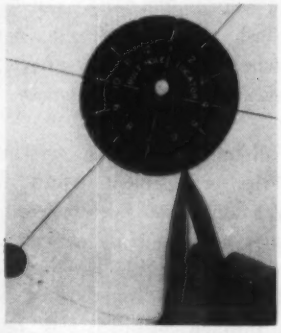
. . . of type 316 stainless steel—*Band-It Co., Dept. HPAC, 4777 Dahlia St., Denver.*

Unit designed to provide maximum flow, greater holding qualities in hose, and to extend hose life by minimizing abrasive action of nipple end. Available in sizes $\frac{1}{4} \times \frac{1}{4}$, $\frac{3}{8} \times \frac{3}{8}$, $\frac{1}{2} \times \frac{1}{2}$, $\frac{3}{4} \times \frac{3}{4}$, 1×1 in.; also offered in 19 sizes of carbon steel, eight sizes of brass. Recommended by company for following industries: high temperature chemical processing, textile, pulp and paper, marine, rubber, food processing, petroleum, edible oils, plastics, brewing, distilling, water systems, atomic energy, refrigeration, related industries where corrosion problems often exist.

Piston Pumps . . .

. . . for shallow well applications — *Lancaster Pump & Mfg. Co., Inc., Dept. HPAC, Lancaster, Pa.*

Model "403" has capacity of 275 gph against 40 lb pressure. Model "404" delivers 375 gph against 50 lb pressure. Both available on 12, 17, 30 gal tanks. Pumps have variety of features including automotive type oil dip stick, company says.



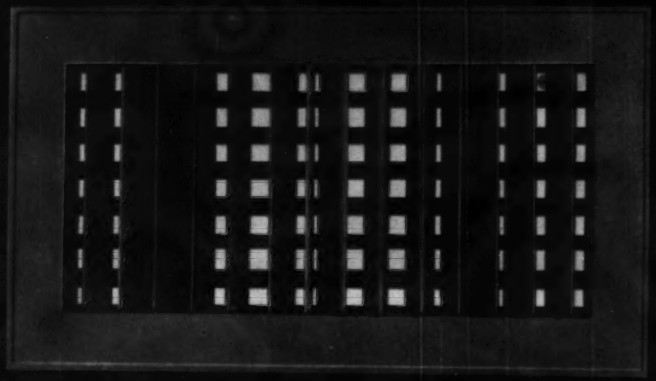
Gasket Cutter . . .

. . . designed for fast location of bolt holes—*Zimmerman Packing Co., Dept. HPAC, 2768 Highland Ave.,*

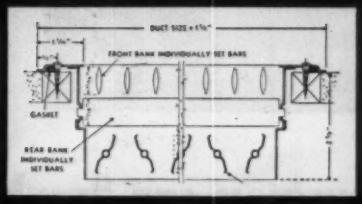
No. 190 LINES OF MULTI-FLEX REGISTERS Lead All Over the World

No. 190—for those better COMMERCIAL, INDUSTRIAL CONTRACTS

and All Applications where Air Handling must be Engineered at its best.

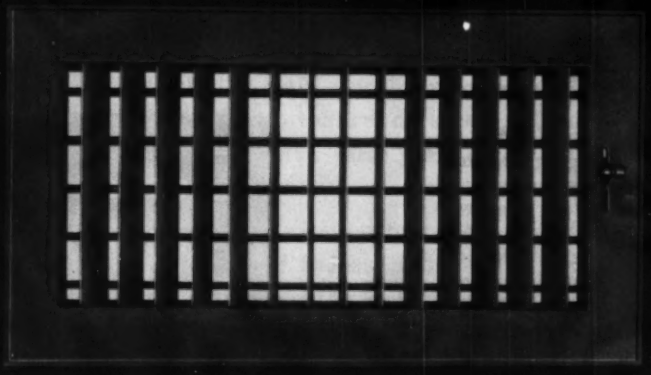


Distributes Diffused Air in any and all desired directions EVENLY and SILENTLY. Assures the Most Satisfactory Performance on every Heating-Cooling System. SCREW-DRIVER OPERATED OPPOSED valves (no loose keys to lose).

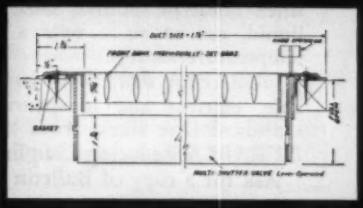


No. 192-L—a Lower Cost but very Efficient Multi-Flex Register

for Sidewall COMMERCIAL, RESIDENTIAL Air Conditioning Systems.



Parallel Lever-Operated rear valves make possible Up-Flow and Down-Flow change-overs from warm to cool air conditioning almost Instantaneous! Lateral Diffusion is obtained by individually set Double-Edged, Low-Resistance vertical grille bars.



Learn to know these VERY SUPERIOR LINES of U.S. 190 Series. You will create friends and increase profits wherever they're used.

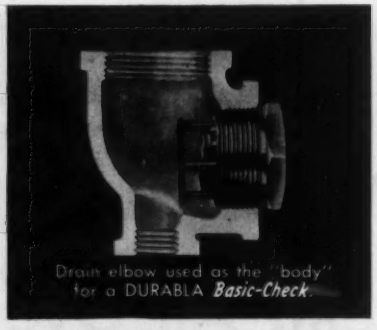
Write for latest catalog and prices.

UNITED STATES REGISTER COMPANY

BATTLE CREEK, MICHIGAN

MINNEAPOLIS • KANSAS CITY • ALBANY

Check valve formed from *Basic-Check* Unit and standard reducing coupling.


Drain elbow used as the "body" for a DURABLA *Basic-Check*.

Basic-Check used with a standard side inlet.

Basic-Check at inlet end of this bend completes the check valve.

How you can "make" a check valve to meet any emergency

Just take a DURABLA *Basic-Check* Unit . . . combine it with any standard pipe fitting . . . and you have a complete check valve that's perfect for practically any service. Keep a few *Basic-Check* Units on hand and you are prepared for any emergency.

Because it will operate in any position, the DURABLA *Basic-Check* can be installed without changing existing lines. Made of stainless steel, they'll handle almost any liquid, gas or air . . . over a broad range of pressure-temperature ratings.

DURABLA *Basic-Check* Units are versatile, dependable, efficient and inexpensive. They come in seven standard line sizes, from ⅜" to 2". Also available: DURABLA Reducing Couplings of stainless steel.

Ask for a copy of Bulletin HPAC-48.

DURABLA MANUFACTURING COMPANY
114 Liberty Street, New York 6, New York

DURABLA®

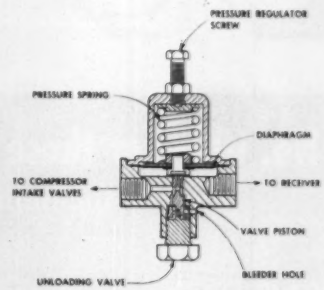
DM-32

EQUIPMENT DEVELOPMENTS

Continued

Cincinnati 12.

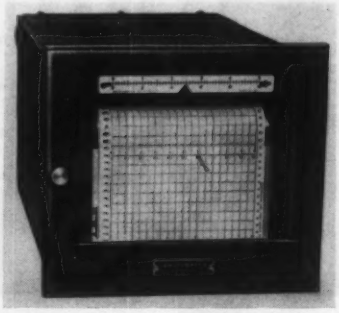
"Bolt hole locater" on cutter is placed over pivot pin in center of gasket. Equally spaced, notched instruments indicate center point of bolt hole.



Air Compressor Valve . . .

. . . for controlling operation of air compressors when they are equipped with suction unloading valves—*Techno Corp., Dept. HPAC,* 16 *W. Fifth St., Erie, Pa.*

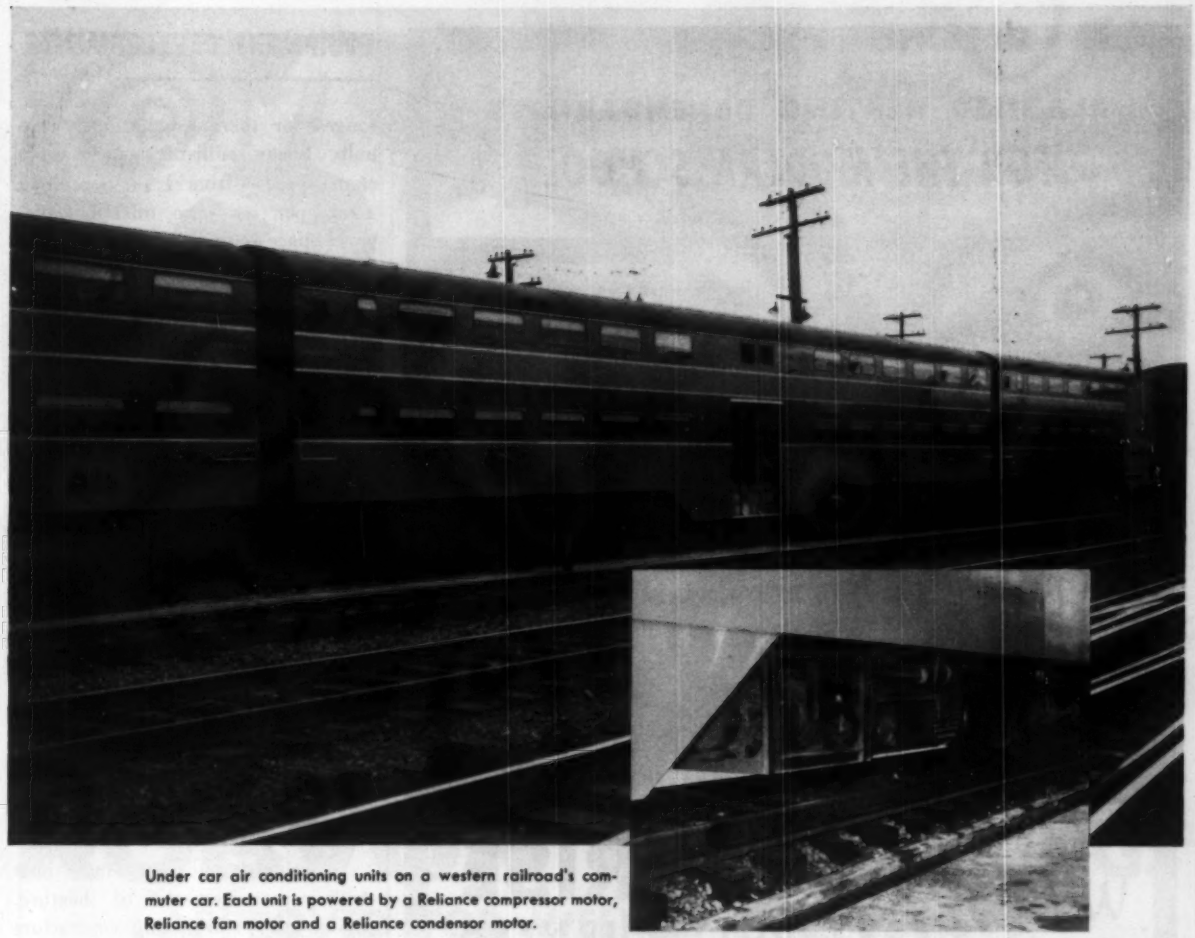
"Technomatic" maintains constant pressure on receiver regardless of load, according to manufacturer. Unit is adaptable to any type of compressor having unloading suction valves, regardless of type of drive. Self-actuating unit requires no electrical connections. There is one moving part, with single adjustment. Can be furnished equipped with solenoid valve for automatic starting during initial unloaded period.



Temperature Recorder . . .

. . . with plug-in range resistor features—*Westronics Inc., Dept, HPAC,* 3605 *McCart St., Fort Worth, Texas.*

Potentiometer recorder with 5 in. strip chart available with variety of



Under car air conditioning units on a western railroad's commuter car. Each unit is powered by a Reliance compressor motor, Reliance fan motor and a Reliance condensor motor.

You bet it's rugged service, but Reliance Motors keep these cooling units running

Track ballast, dirt, rain—nothing has altered the top performance of these Reliance Motors, even after three years of operation.

Metermatic bearing lubrication, protected windings, weather proof frames, and just plain good quality have kept these Reliance Motors going under punishing conditions.

Few applications are as tough as this one. But tough or easy Reliance Totally-Protected Motors give years of trouble-free performance with a minimum of maintenance.

Get all the facts on Reliance Totally-Protected Motors from your Reliance Representative, or write today for a copy of "Check the Facts" Bulletin No. B-2401.

B-1597

RELIANCE ELECTRIC AND ENGINEERING CO.

DEPT. 364A, CLEVELAND 17, OHIO
CANADIAN DIVISION: TORONTO, ONTARIO
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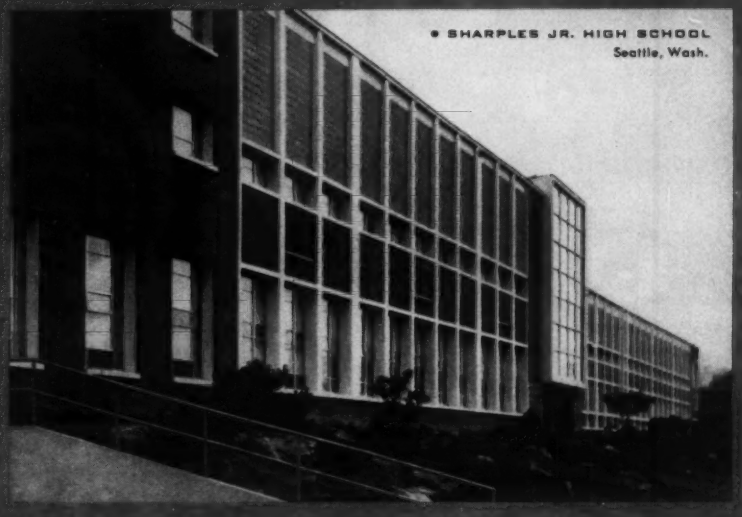
PLANNED HEATING DEPENDABILITY

FOR THE MODERN SCHOOL



with ENTERPRISE HEAVY DUTY BURNERS

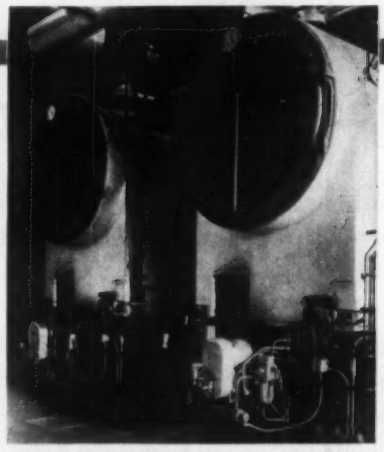
Enterprise distributors, backed by extensive factory experience and facilities, offer complete assistance in planning, designing and engineering your burner installation.

Architects
Mallis, DeHart and Hopkins

Consulting Engineer
Marius Anderson

Heating Contractor
W. E. Beggs, Inc.

Installed by
A. Wilcox Company



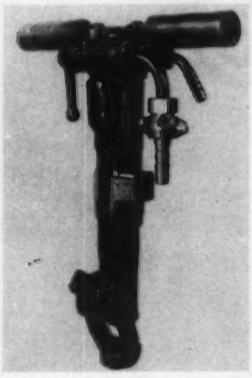
Two Enterprise Burners have provided 6 years of reliable service for this school with minimum maintenance. Enterprise Burners are available in sizes from 4 to 200 gph.

..ENTERPRISE..... *dependable* **BURNERS**

ENTERPRISE ENGINE & MACHINERY CO.
Subsidiary of General Metals Corporation
18th and Florida Sts., San Francisco 10, California

EQUIPMENT DEVELOPMENTS
Continued

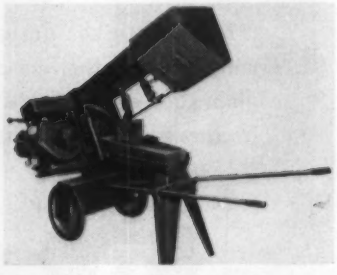
ranges for thermocouple, resistance bulb, linear millivolt spans. Wide chart speeds—from 1 in. per hr to 2 in. per sec—also offered. Total panel space required: 9⅝ in. × 8½ in. Weight is approximately 25 lb. Optional features include quick change chart drive, retransmitting slidewire, event marking pens, limit switches.



Masonry Drill . . .

. . . designed to meet small hole drilling requirements of heating, piping, air conditioning contractors —*Atlas Copco Eastern, Inc., Dept. HPAC,* 151 *Linwood Ave., Paterson, N. J.*

"Terrier" drill weighs 24½ lb, measures 17½ in. Drawing 42 cfm, it delivers 2650 blows per min. Chucks for both ¾ × 4¼ in. and ⅞ × 4¼ in. drill steel shanks available. Air coupling designed for ⅝ in. hose. Piston bore is 1¾ in., piston stroke, 1⅝ in.



Portable Band Saw . . .

. . . developed for use primarily where power is not readily available —*Machine Tool Div., Kalamazoo Tank & Silo Co., Dept. HPAC,* 500 *Harrison St., Kalamazoo, Mich.*

- NUB diameter automatically sets welding gap for root pass.
- Robvon Backing Rings Form perfect welded-joints eliminating slag and icicles.
- Robvon Backing Rings Allow complete penetration and fusion.
- Robvon Backing Rings Eliminate the necessity of tack welding.
- Robvon Backing Rings Radiograph perfect certified welds.

ROBVON BACKING RINGS

APPROVED FOR WELDED PIPE, VALVES, AND FITTING JOINTS

Available in carbon steel, wrought iron, chrome alloys stainless steel, aluminum and copper

TYPE CCC Designed for quick easy alignment of pipe where the variation in inside diameters is relatively great. Chamfered NUBS allow close tolerance fit-up and CLEAN STRIKE OFF. The ROBVON NUB conforms to the diameter of weld rod. ROBVON rings are beveled to assure non-restricted fluid flow.

TYPE CC Designed to allow quick easy alignment of pipe where the inside diameters are slightly out of round. The welder has the choice of "STRIKING OFF" the NUBS or leaving them intact to be melted into the weld mass of the first root pass.

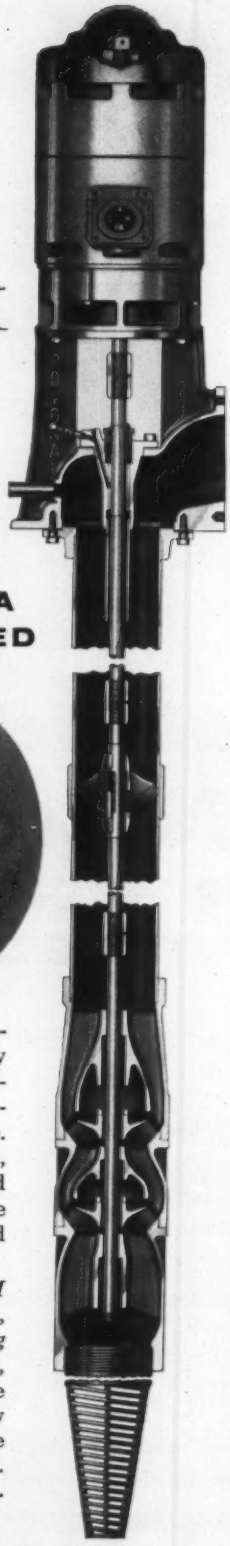
TYPE C Designed for precise close tolerance fit-up. Type "C" NUBS conform to the diameter of the weld root. The NUBS melt with the metal to give complete penetration and fusion.

Robvon also manufactures machined rings to customer's specifications
All fabricated solid machined rings x-rayed. Write for full information

ROBVON
BACKING RING COMPANY

675 GARDEN STREET ELIZABETH, NEW JERSEY

You'll want to look into this pump



NEW F-M POMONA WATER-LUBRICATED TURBINE PUMP

For ruggedness of construction, simplicity of maintenance, and strictly quality design throughout—this all-new Fairbanks-Morse Pomona turbine pump is today's greatest value. No other pump is so easily installed, so easy to adjust for varying field conditions, so simple to change between electric, belted or geared drive.

Ask for details on this new F-M Pomona pump for raw water supply, air conditioning, refrigeration, cooling towers, sump pumping, dewatering, etc. Contact your Fairbanks-Morse Sales Engineer today. Ask for new illustrated Bulletin 6957-1. Or write Fairbanks, Morse & Co., 600 So. Michigan Ave., Chicago 5, Illinois.

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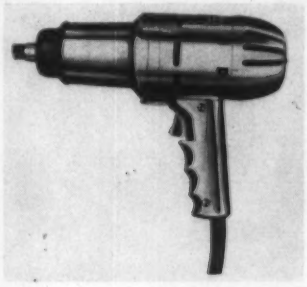
a name worth remembering when you want the BEST

PUMPS • SCALES • DIESEL LOCOMOTIVES AND ENGINES • ELECTRICAL MACHINERY • RAIL CARS • HOME WATER SERVICE EQUIPMENT • MAGNETOS

EQUIPMENT DEVELOPMENTS

Continued

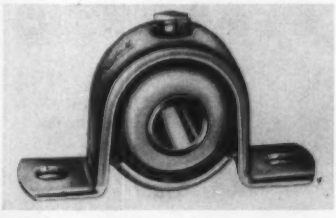
Two hp gasoline engine powers "Kalamobile" or "Model 610D" metal cutting band saw. Unit is rolled on 12 in. rubber tired wheels. Collapsible handles are telescoped into handle tubes.



Impact Wrench . . .

. . . with rated capacity for running, removing nuts on bolts to 3/8 in. (5/8 in. under favorable conditions)—*Millers Falls Co., Dept. HPAC, 57 Wells St., Greenfield, Mass.*,

"Model No. 777" has 1/2 in. square drive, produces 2000 impacts per min, develops 100 ft-lb torque. Power in either direction achieved by brushes which automatically shift as reversing switch is turned. Motor runs continuously, cannot be stalled, says company. Unit weighs 7 1/4 lb.



Pillow Block . .

. . . combining strap type housing with rubber isolated sleeve bearing cartridge—*Randall Graphite Bearings, Inc., Dept. HPAC, Greenlawn and Lake Sts., Lima, Ohio.*

Available with either double-lubricating or sintered bearing, unit is intended for shaft sizes 1/2 to 1 in. Housing is 16 gage steel; all steel parts are cadmium plated to resist corrosion. Unit is 4 in. long, 2 in. high, 1 1/8 in. wide; can be mounted on hole centers from 3 to 3 1/4 in., using 5/16 in. bolts. Shaft center is 1 in.

Wheatland Steel Pipe . . . for

DURABILITY

Talk about durability! On July 8, 1889, John L. Sullivan went 75 rounds with Jake Kilrain before he finally won the heavyweight championship of the world. This was the last bare-knuckle title fight.

...pipe with the yearmark!

You can be sure of long, trouble-free service when the steel pipe you specify bears the mark "Wheatland—58." This is the pipe built by specialists to meet the most rigid tests of endurance. It's the pipe with the "look of quality" and performance to back it up.

For information about Black or Galvanized Steel Pipe, contact:

WHEATLAND TUBE CO.

BANKERS SECURITIES BUILDING, PHILA. 7, PA. • MILLS: WHEATLAND, PA. • DELAIR, N.J.

Norman Schoolroom Heating and Ventilating System

VERSATILE . . . adapts to any schoolroom. May be installed along part or all of exposed wall, then continued around corner if room has two exposed walls, or through wall into adjacent room.

TWO SIZES . . . choice of 85,000 or 100,000 BTU/hr. input to meet requirements of any size classroom.

UTIL-I-DUCT, WALL-I-DUCT . . . bookshelf sections add work-top and storage space to classrooms. Thin Wall-i-Duct sections save room space. Two types of ducts can be used together.

RIGHT-OR LEFT-HAND MODELS . . . these individual central heating units can be installed at either end of exposed wall. Two systems can be used together in large rooms. Systems in adjacent rooms can be extended from a common partition wall with flues from both heating units housed in the same partition.

FLEXIBILITY . . . individual schoolroom-packaged heating and ventilating systems mean greater freedom in planning new schools, and important economy in planning future additions.

IN CANADA: A. D. PALMER PRODUCTS LTD., Lethbridge, Alberta—A. D. PALMER & CO., Port Credit, Ontario

Norman® products company

NORMAN PRODUCTS CO.
1156 Chesapeake Ave., Columbus 12, Ohio
We want to learn more about Norman Products for School Comfort. Please send complete information to:

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COMPANY NAME_____

ADDRESS_____

CITY_____ ZONE____ STATE_____

See Sweet's Arch. File 30H, American Sch. and Univ. Annual C-1/no

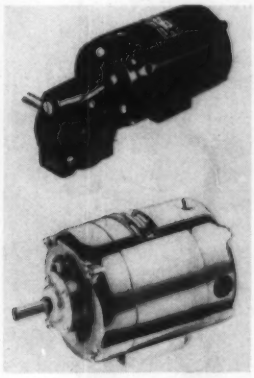
EQUIPMENT DEVELOPMENTS

Continued

Brazing Alloy . . .

. . . for higher strength, oxidation resistance applications where erosion must be controlled—*Wall Colmonoy Corp., Dept. HPAC,* 19345 *John R. St., Detroit* 3.

"Nicrobraz 150" is nickel base material containing chromium bromides suited for use in fabrication of parts such as turbine blades, rotor shafts, highly stressed sheet metal structures. Available in form of powder, rod, paste, plastic bonded wire. Resists oxidation to 1800 F. Joints are ductile, permitting 720 deg twist without fracture. Joint strength is of the order of 34,000 psi tensile shear. Recommended brazing temperature is 2150 F.



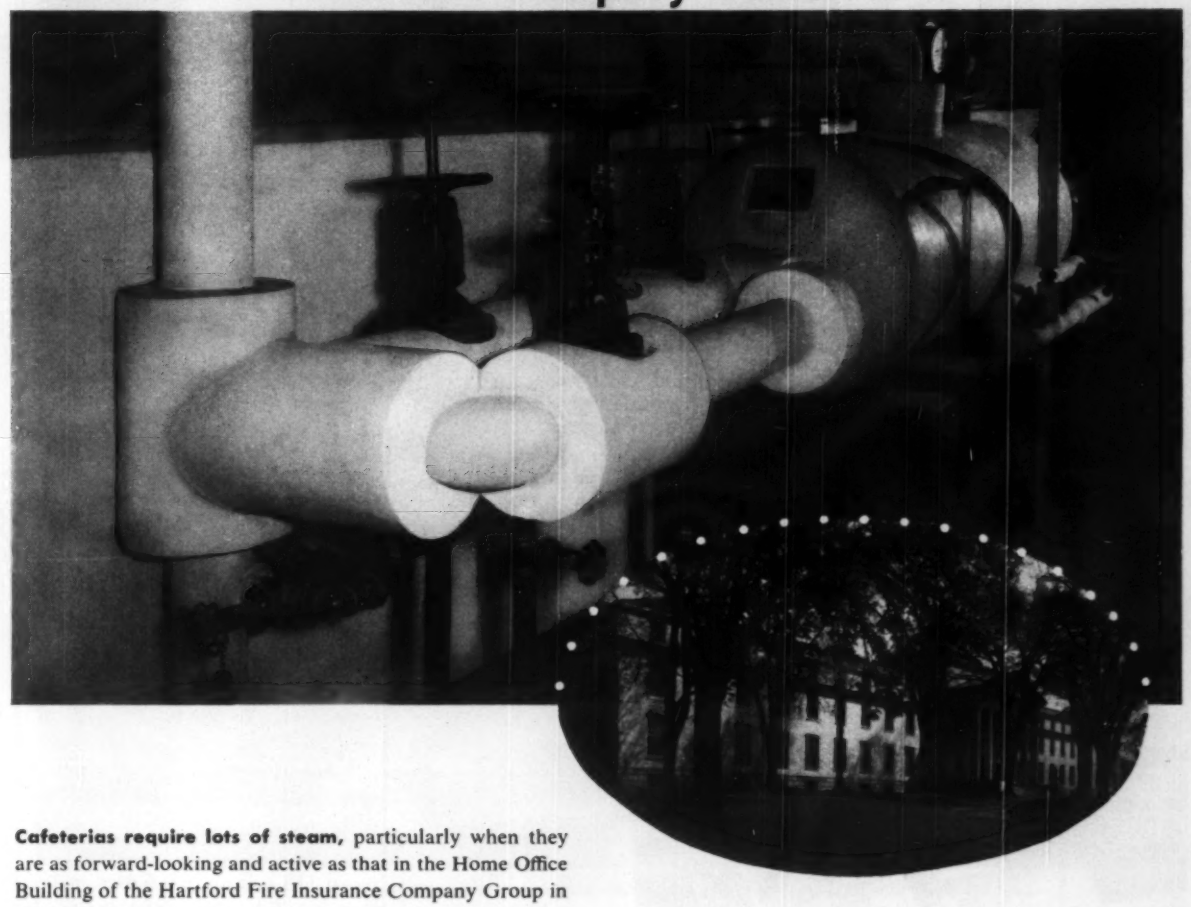
Motor, Gear Unit . . .

. . . with normalized zinc or alumium castings for accuracy, performance over wide temperature range—*Howard Industries, Dept. HPAC, Racine, Wis.*

Model "1-23" has series type horsepower ratings for continuous duty of 1/30 to 1/5 hp at full load speeds of 3000 to 15,000 rpm, with range of 24 to 250 volts 60 cycle d-c; performance for intermittent duty: 1/30 to ½ hp at speeds of 3000 to 15,000 rpm (dependent upon duty) with range of 6 to 250 volts 60 cycles d-c. Shunt-type motors at speeds of 1000 to 7500 rpm available; horsepower ratings to 1/10 for intermittent and 1/20 hp continuous duty. Model "A-26" single reduction gear unit has torques up to 50 lb, available with bronze and plastic gears in ratios 10:1 to 60:1.

WHITLOCK STEAM GENERATOR

Selected for Insurance Company Cafeteria



Cafeterias require lots of steam, particularly when they are as forward-looking and active as that in the Home Office Building of the Hartford Fire Insurance Company Group in Hartford, Connecticut, serving about 1,100 lunches daily. Every operating detail of this modern, efficient, "last word" cafeteria was carefully selected to assure long life and reliable, economical performance. The Whitlock Steam Generator selected for this installation has fully met expectations in every way and its record of low operating cost is most satisfactory.

You'll find water heating equipment by Whitlock in many important buildings from coast to coast — office buildings, hospitals, laundries, hotels, schools, and industrial plants . . . large and small. Whitlock Steam Generators, Storage Heaters, Instantaneous Heaters, and Convertors have an outstanding reputation for performance, and their proven design means minimum operating and maintenance costs. Long experience enables us to offer standardized water heaters for the majority of applications . . . we also design and build water heaters for special needs.

We will gladly assist you with any water heating problems . . . ask us for suggestions and illustrated bulletins.

Whitlock HEATERS

THE WHITLOCK MANUFACTURING CO.

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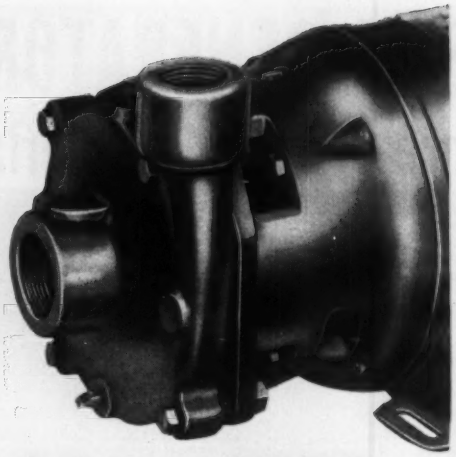
NEW YORK • BOSTON • CHICAGO • PHILADELPHIA • DETROIT • RICHMOND

Authorized representatives in other principal cities

In Canada: DARLING BROTHERS, LTD., MONTREAL

FROM WEINMAN, for the air conditioning industry...



SPECIALIZED PUMPS

WEINMAN TYPE AC UNIPUMPS are designed *specifically* for use in circulating cooling water through condensers, compressors, and direct cooling units and over cooling towers in air conditioning systems.

The compact size and versatile mounting features of WEINMAN TYPE AC UNIPUMPS simplify installation in even extremely limited space. They work in any position . . . can be mounted on floor, ceiling or wall, with the shaft horizontal, vertical or at an angle.

A specially designed seal prevents leakage caused by the abrasive action of dust laden liquids.

Available in a great variety of sizes with a wide choice of motors, WEINMAN TYPE AC UNIPUMPS will give long life, trouble free, high capacity pumping service in any installation.

Attention Air Conditioning, Heating and Ventilating engineers, contractors, equipment manufacturers . . . eliminate many pump problems by installing WEINMAN TYPE AC UNIPUMPS. Write today for a free copy of illustrated WEINMAN Bulletin No. 100. Gives specifications, dimensions, construction features, performance curves and complete selection table.

THE WEINMAN PUMP MFG. CO.
290 SPRUCE ST. COLUMBUS 8, OHIO

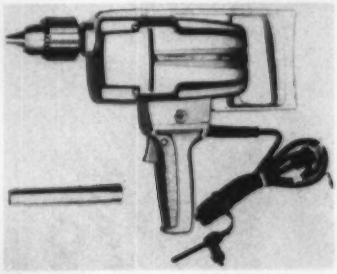
EQUIPMENT DEVELOPMENTS

Continued

Humidifier Cleaner . . .

. . . formulated to dissolve scale, corrosion, rust, solids from humidifiers, plates—*Garman Co., Inc., Dept. HPAC*, 1253 *Grover Rd., St. Louis* 23.

"Vapco" cleaner is dry powder packaged in 12 oz cans. Can of powder mixed with 2 gal hot water makes solution for cleaning humidifiers, similar equipment where water is evaporated, minerals left behind.



Electric Drill . . .

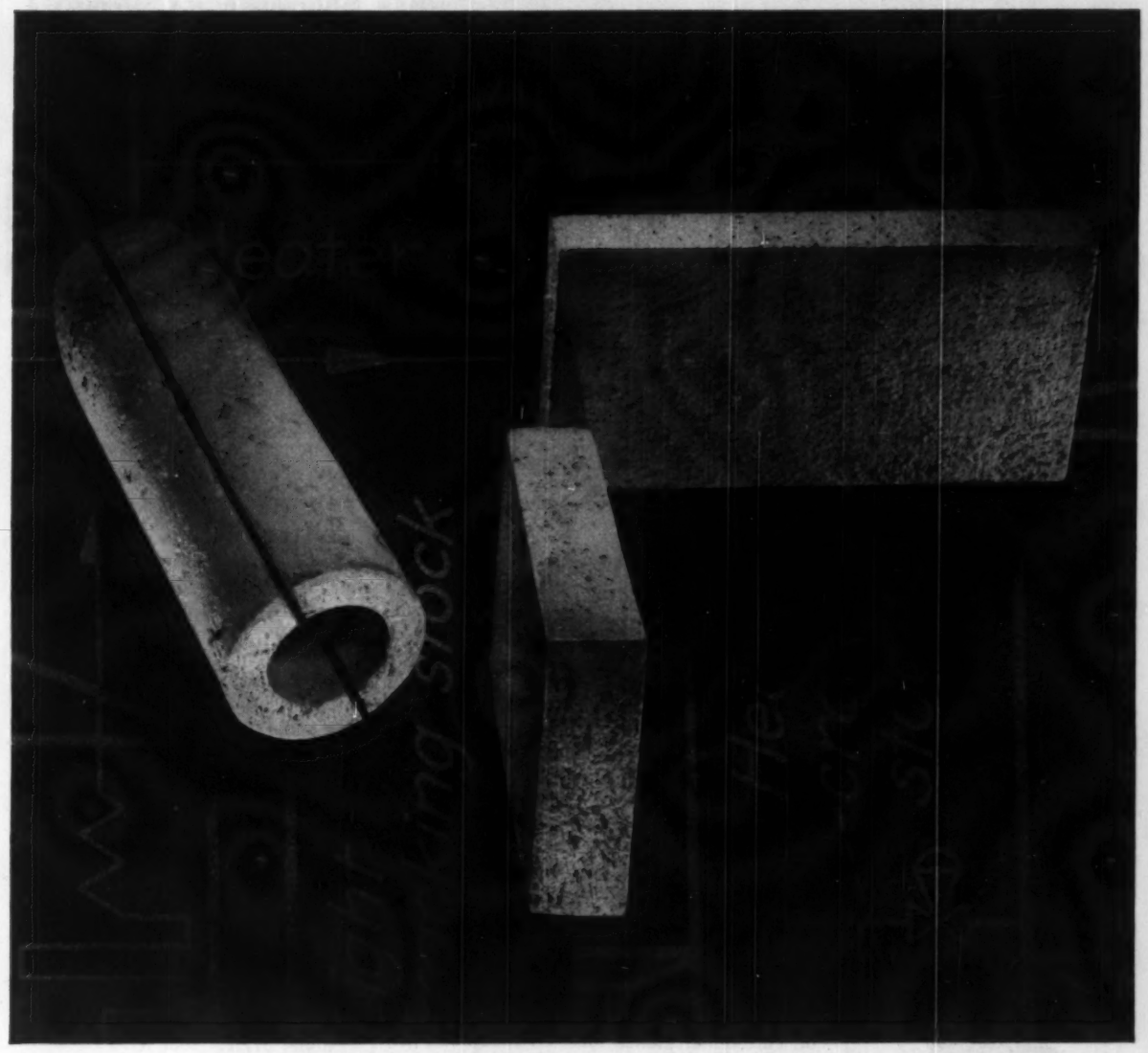
. . . designed to reverse at flick of switch for routing lines, reaming pipes, right and left handed threading, other jobs—*Portable Electric Tools, Inc., Dept. HPAC*, 320 *W. 83rd St., Chicago* 20.

"Shopmate Model 520" features cited: high power-weight ratio, due to aluminum die casted housing; three-jaw precision gear chuck; Universal 115 volt a-c/d-c 6 amp motor; heat treated alloy steel gears in grease tight housing; oil retaining bronze bearings with ball thrust bearing on spindle.

In-Wall Unit . . .

. . . provides pilaster-to-pilaster heating or cooling with only one set of risers—*I. W. Air-Conditioning Corp., Div. of I. Wenig & Sons, Inc., Dept. HPAC*, 230 *Manida St., New York* 59.

Continuous hot water convector runs width of room with convector fins each side of centered air conditioner, makes only one set of risers necessary. Unit has built-in thermostat, calibrated in degrees. Available in ¾, 1, 1½ ton sizes.



In petroleum refining, as in other process industries, "K&M" Insulations last the life of the equipment.

"K & M" High-Pressure Insulations permit more precise process control!

Permanent and trouble-free, "K&M" High-Pressure Insulations provide peak heating efficiency, lower fuel costs, and tighter heat control year after year. Maintain their insulating efficiency in spite of temperature changes, and other normal operating conditions.

Write to us today for a free brochure which shows how you can cut heating costs.

For temperatures up to 1900°F., use "K&M" Hy-Temp Combination—diatomaceous silica overlaid with "K&M" "Featherweight" 85% Magnesia. Staggered joints prevent heat loss through expansion-caused openings.

For temperatures up to 1350°F., use "K&M" Kaytherm—hydrous calcium silicate bonded with asbestos fibers. Important for power and petroleum applications.

For temperatures up to 600°F., use "K&M" "Featherweight" 85% Magnesia—a basic carbonate of magnesia mixed with asbestos fibers.

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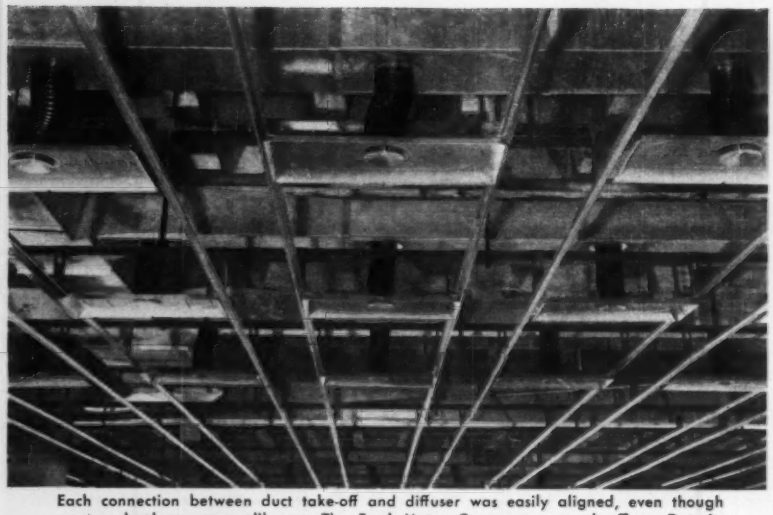


Each connection between duct take-off and diffuser was easily aligned, even though no two hookups were alike. — The Ford Motor Company general offices, Detroit.

more and more contractors use WIREMOLD AIR DUCT to avoid alignment problems

Construction—The exclusive Wiremold construction locks fabric to metal securely. This positive mechanical lock guarantees long life — no adhesives are used.

Problem: Numerous connections between branch duct take-offs and diffusers, no two of which were alike. Use of rigid ducting would have involved considerable trimming and fitting, complicated by the fact that duct take-offs and diffusers were not aligned.

Solution: Wiremold Air Duct. Its flexibility eliminated alignment problems. It was simple to connect and cut to size.

Because Wiremold is so light, flexible and easy to install, many contractors have been using it in ways that even we hadn't thought of. Furthermore, under identical conditions, the friction loss of Wiremold is only slightly more than for rigid duct work — normally not enough to require any increase in fan capacity.

These are just a few reasons why more and more contractors are using more and more Wiremold Air Duct.

FIVE COMMON USES

1. To connect perimeter underwindow units with vertical risers.
2. To connect branch duct to single ceiling outlet.
3. From attenuation box to outlets in modular ceiling.
4. Between branch duct and attenuation box, on the high pressure side.
5. Vertical take-off from branch runout to ceiling pan-type outlet in low and medium pressure systems.

FOR FURTHER INFORMATION SEND FOR FOLDER NO. 591 and DATA SHEET S-11.

WIREMOLD® FLEXIBLE AIR DUCT

THE WIREMOLD COMPANY, HARTFORD 10, CONNECTICUT

EQUIPMENT DEVELOPMENTS

Continued

Equipment Briefs . . .

HOSE ASSEMBLY TOOLS for assembly of re-usable "Hoze-lok" fittings onto rubber covered no-skive hydraulic hose—*Parker Fittings & Hose Div., Parker-Hannifin Corp., Dept. HPAC,* 17325 *Euclid Ave., Cleveland* 12. Speed wrench sets, strap vise accommodate all fittings through 1⅛ in. in single wire braid construction, 1¼ in. in double wire braid hose.

FASTENER HOLDERS, DRIVE RODS designed to further broaden uses of fastening tool — *Ramset Fastening System, Winchester-Western Div., Olin Mathieson Chemical Corp., Dept. HPAC,* 12117 *Berea Rd., Cleveland* 11. Units improve fastening efficiency for installation of protector mountings, tubing clips for temperature control, manufacturer says.

TIME INDICATOR built around self-starting, synchronous clock motor —*Simpson Electric Co., Dept. HPAC,* 5200 *W. Kinzie St., Chicago* 44. Indicators operate on 120 or 240 volt, contain automatic resetting counters reading either 0-99999 or 0-9999.9 hours. Available in three models: "Model 57ET," sold from stock with 3½ in. rectangular case; "Model 55ET," with 3½ in. round case; "Model 56ET," with 3½ in. round shroud case.

TANK LININGS makes possible lining of large areas with minimum of installation problems—*Wagner Bros. Inc., Equipment Div., Dept. HPAC,* 7800 *Dix Rd., Detroit.* "Vyflex Fligid" is said to protect base materials of both ferrous and nonferrous metals, concrete as well as wood. Resists broad line of corrosive chemicals, from concentrated oxidizing acids to highly concentrated alkalies, number of corrosive organic chemicals. In continuous sheets, material consists of unplasticized polyvinyl chloride. ∓

YORK-POWER OFFERS NEW PAKETTE BOILERS FOR HEAVY OR REGULAR DUTY SERVICE

Small in Size, but Big in Performance

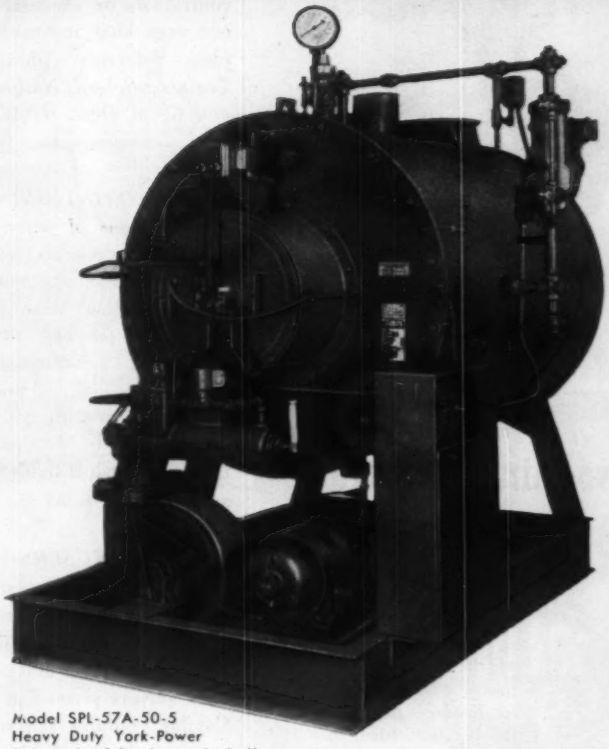
York-Power Pakettes—compact packaged boilers in sizes from 10 hp. up—offer all of the features of the large Steam-Pak automatic boilers for which York-Power is justly famous. Now York-Power offers two diversified lines of Pakettes—heavy duty and regular duty—for high or low pressure steam or hot water.

Heavy Duty Pakettes features a wet-back head and divided baffle arch—features that provide long life and extremely low fuel and maintenance costs.

Regular Duty Pakettes fit most applications where high operating efficiency and low cost operation with automatic boiler are required.

All Pakettes are available for firing heavy or light oil and combination fuels. They offer savings on maintenance, breeching, chimney, installation costs and on wiring.

York-Power Pakettes are ideally suited both for cost and space saving for dairies, heating plants, laundries, bottling, dry cleaners, and industries where quantities of steam and hot water at proper pressures and exact temperatures are required.



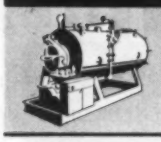
Model SPL-57A-50-5
Heavy Duty York-Power
Pakette for firing heavy fuel oil.

Check over these York-Power Pakette MONEY-SAVING FEATURES

- **Compact design saves floor space.**
- **Fully wired electronic safety controls assure positive, safe, economical operation.**
- **Exclusive Iris Shutter provides perfect metering of air.**
- **Built-in forced draft, eliminates costly stack.**
- **Viscosity compensator with heated metering ports assures perfect heavy-oil circulation.**
- **"Swing away" rear door for quick easy cleaning.**

York-Power Pakettes are sold through Supply Houses. A few choice distributorships are still open.

Industrial Division **YORK-SHIPLEY, Inc.** YORK, PA.



STEAM-PAK
15 to 600 Hp.
Oil and/or Gas Firing

PAKETTE
10 to 50 Hp.
Oil and/or Gas Firing

FIRE-PAK
35 to 485 Hp.
Oil and/or Gas Firing

SCOT-PAK
52 to 400 Hp.
Oil and/or Gas Firing

Industrial Division York-Shipley, Inc. York, Pa.

.....Please send me your new illustrated brochure showing the new York-Power Pakette line.

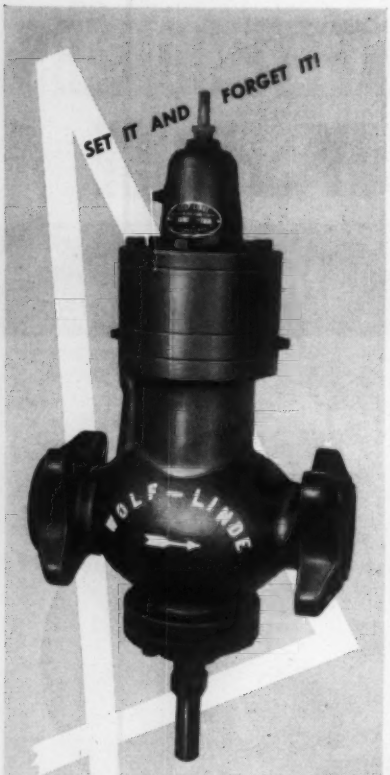
.....Have your representative call and give us further information.

Name .....

Company .....

Address .....

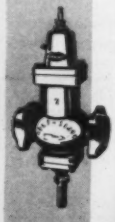
City..... Zone..... State.....



wolf-linde evaporator pressure controls

are the automatic pilots in the cooling systems for hundreds of today's finest refrigeration installations.

Regardless of the size of your system, or refrigerant used . . . whether the pressure is above atmospheric or below . . . there is a Wolfe-Linde control that will do your job efficiently, automatically, and *at the lowest possible cost.* Your inquiry invited.



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RECENT TRADE LITERATURE . . .

▸ *AIR CONDITIONING SCHOOL BOOKLET*—Newly issued booklet gives information on company's air conditioning school, which is open to qualified heating, air conditioning contractors or wholesalers. Course is one week long and tuition free. Complete reference library available. *Training School, National-U.S. Radiator Corp., Dept. HPAC,* 221 *Central Ave., Johnstown, Pa.*

▸ *AIR CONDITIONING UNITS*—Specifications of seven models with static pressures up to 9 in. water gage given in new catalog AC4 of "Tru-Air" line. High pressure units of spray coil and dry coil types, completely pre-assembled, in sizes 4590 cfm at 3 in. and 30 tons to 28,160 cfm at 9 in. SP, and 185 tons are cataloged. *M. Blazer and Son, Dept. HPAC,* 173 *Market St., Passaic, N. J.*

▸ *AIR DIFFUSERS*—Catalog No. 1-58 describes, illustrates company's line of grilles and registers. New products featured: airline grilles and registers, curved louvers and grilles with louvers pivoted at front, others. Catalog contains selection tables for each of 26 standard sizes for new grilles with curved louvers. *Waterloo Register Co., Inc., Dept. HPAC, P.O. Box* 72, *Waterloo, Iowa.*

▸ *AIR VELOCITY CALCULATOR*—Two-color, plastic, 3 × 8 in. calculator provides all information usually supplied on conventional air velocity charts, with individual problem settings, direct readings. Front side of sliding scale shows air velocity corresponding to impact pressure from 0.01 to 10 in. of water, compensated for air density. Back side provides means of determining exact air density with corrections for relative humidity dry bulb temperature, barometric pressure. *F. W. Dwyer Mfg. Co., Dept. HPAC, P. O. Box* 373, *Michigan City, Ind.*

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for all high-pressure installations

Full couplings and half couplings are available from stock for prompt shipment in all sizes from ⅛" through 4".

Manufactured to ASTM Specifications A-105.

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"WHEN YOU ORDER ME,

I'M ON MY WAY THE SAME DAY!

Here's the end suction pump line that combines performance, efficiency, versatility, convenience and *immediate availability* all in one package – the Peerless REDI-PAK. Comprised of 22 of the most popular size Fluidyne pumps, in sizes from 1 to 15 hp, the individually packaged, factory-fresh pumps are available *right now!* They're versatile, able to handle nearly every general purpose pumping job. They're well designed and soundly constructed. They're a compact pumping unit that fits easily into most all piping layouts. They're easy to maintain, operate indoors or outdoors, on continuous or intermittent duty.

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NAME_____ POSITION_____

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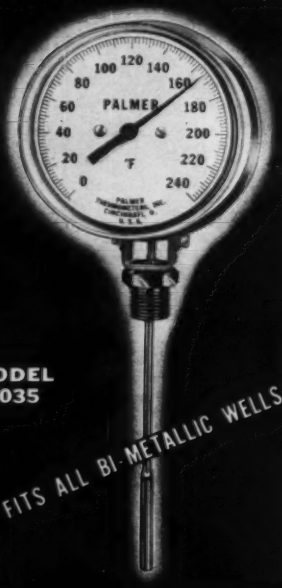
Outstanding Accuracy

PALMER

Dial Thermometer



Check these functional features

- Direct-drive Bourdon Coil with a filled system for longer lasting accuracy.
- Stem can be placed at any desired angle and case can be rotated to most readable position.
- External calibration for zero setting.
- Unaffected by stem alignment.
- Accurate to one scale division.
- No sticking at any temperature.
- Non-corrosive case.

PALMER

THERMOMETERS, INC.

Mfrs. of Industrial Laboratory, Recording and Dial Thermometers

2515 Norwood Ave., Cincinnati 12, O.

RECENT TRADE LITERATURE

Continued

▸ *ALUMINUM AIR DUCT GUIDE*—New 130 page book with over 350 illustrations outlines the advantages of aluminum for air ducts, discusses recommended alloys, tempers with their properties, prefabricated ducts, details for noise control in ductwork. Book includes chapters on engineering, drafting, estimating, fabricating, installing aluminum ductwork. Chapter on engineering has 36 tables covering data on heating capacities of aluminum ducts, 4 to 8 in. diam., duct entrance pressures 15, 20, 25 in. water, and duct entrance temperatures 150, 170 F. *Reynolds Metals Co., Dept. HPAC, P.O. Box* 1800-*A, Louisville.*

▸ *ALUMINUM SHEETS*—Illustrated, 320 page book treats aluminum sheet, plate, includes data on aluminum and its alloys. Tables show aluminum characteristics needed to select best suited alloys for manufacturing processes. Formability, machinability, weldability of alloys evaluated. Process of sheet and plate aluminum production described, illustrated. Information on forming, bending, machining aluminum is also included. Book must be requested on company letterhead. *Kaiser Aluminum & Chemical Sales, Inc., Dept. HPAC,* 919 *N. Michigan Ave., Chicago* 11.

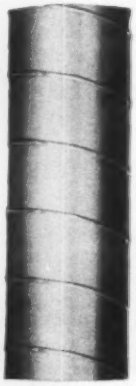
▸ *ALUMINIZED STEEL*—Six page folder tells how manufacturer's "Type 1" aluminized steel resists and reflects heat, retains strength in elevated temperature service. Features cited in folder: low cost, high heat resistance, resistance to heat and corrosion combinations, heat savings. *Armco Steel Corp., Dept. HPAC,* 6957 *Curtis St., Middletown, Ohio.*

▸ *AUTOMATIC CONTROLS*—Illustrated, 60 page catalog No. 858 describes automatic controls for pressure, temperature, liquid level and mechanical movement. Data on relays and both magnetic, tilting type mercury switches also presented. *Mercoid Corp., Dept. HPAC,* 4201 *Belmont Ave., Chicago* 41.

TAKE THE GUESSWORK OUT OF ESTIMATING

High Velocity Air Movement Systems

IN ONE COMPLETE PACKAGE



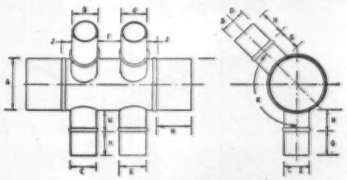
1 SPIRAL *Lockseam* PIPE

Spiral pipe, matched fittings and sound absorbers . . . all custom made to cut costs . . . quicken and pin-point estimates. Next time, specify United's spiral pipe fittings and sound absorbers . . . all in one complete package.

Spiral Pipe Standards and Sizes

• 26 gage zinc-coated steel — diameters 3" through 8" • 24 gage steel—9" through 22" • Standard length 12'—lengths to 20' if required • Available in any specified metal 20 to 30 gage

2 MATCHED FITTINGS AVAILABLE FOR EVERY SPIRAL PIPE DIAMETER



3 SOUND ABSORBERS HIGH PRESSURE LOW FRICTION LOSS

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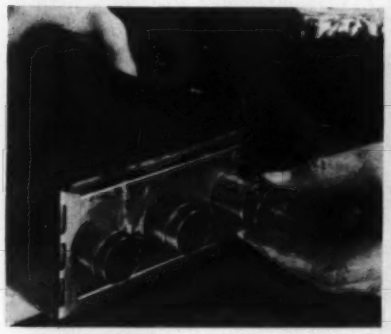
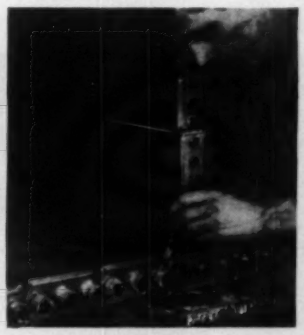
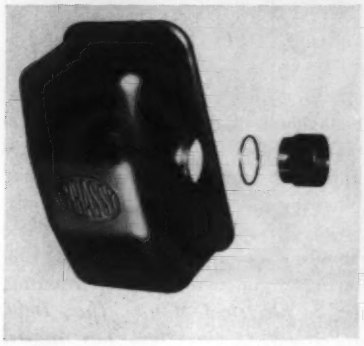
1 EASY-FLO preform ring is slid over header tubes.



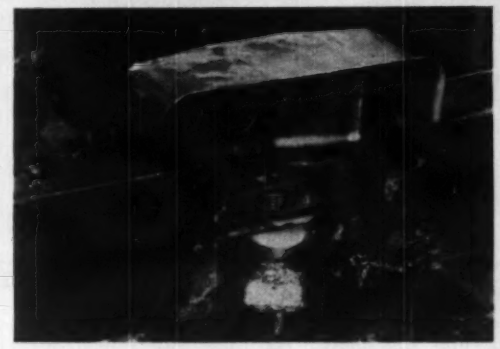
2 Operator fluxes bank of assemblies prior to heating.



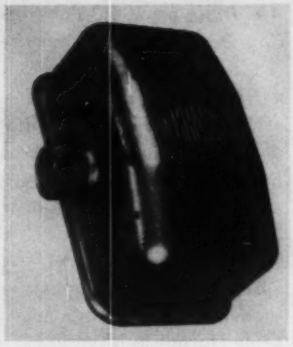
3 Assembly is heated by gas-air burners; heating time: 50 seconds. Note capillary action of alloy; thorough penetration makes strong, leakproof joint.



4 Components of header box; ring is preplaced.



5 Header box under heat; time: 46 seconds.



6 Brazed unit. Note neat, clean fillet around base of tube fitting.

Embassy Steel Products **Cut Unit Labor Cost 50 Per Cent** with **Handy & Harman Silver Brazing**

START WITH BULLETIN 20

It tells you why and how high speed, strength and economy are inherent in silver alloy brazing. Gives information on joint design and brazing methods. A copy is yours for the asking.

Before Handy & Harman Silver Alloy Brazing came into Embassy Steel Products' production picture, these convector radiators were welded. Now, they are brazed with EASY-FLO 35 *using gas-air heat, and unit labor cost has been cut by 50 per cent. This includes cleaning, fluxing and assembling. Not bad, eh?*

Components involved in this big saving are cold-rolled steel header plates that are brazed to fin tubes and cold-rolled steel header boxes that are brazed to steel fittings. Both of these convector assemblies are used in residential heating units.

Preformed EASY-FLO .047 wire (.015 ID) is used for brazing the header plate and fins. Photographs describe the joining steps. Each assembly goes through a 50-second heating cycle.

The header box is made in three sizes — depending on the size of the coil assembly it fits. Average heating time for any size is 46 seconds. Two sizes of EASY-FLO are used: .047 and .062 wire. Switching from one size to another involves no change in assembly or heating setup. Add this to brazing's long list of production benefits and *subtract* it from production costs.

If all we had to talk about in this case was the reduction in production time because of brazing, we'd still have a strong story to tell. You'll notice that we've said nothing about joint strength, alloy cost, corrosion resistance, ductility and so on. We can, and if you'd like to know how these benefits can apply to what you're joining right now, all you have to do is ask us. We'll be happy to tell you.

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RECENT TRADE LITERATURE

Continued

▸ *BLOWER UNITS*—Performance characteristics, dimensions of line of "Vari-Basic" blower units given in 6 page bulletin. Performance curves for each of two widths of each unit size gives static pressure and bhp as functions of flow rate output at four motor speeds. Tables give 15 dimensional specifications for three sizes in two widths for four discharge positions—top horizontal, bottom horizontal, upward, and downward. *Air Impeller Div., Torrington Mfg. Co., Dept. HPAC, Torrington, Conn.*

▸ *BLAST COIL HEATERS*—Newly revised, 24 page bulletin E-97P lists, describes 275 models of company's line made to fit 20 different makes of package air conditioners. Uses, construction, installation, features described in new booklet. Installation specifications on different makes and models of air conditioners given in table form. Schematic wiring diagrams included. *Industrial Engineering and Equipment Co., Dept. HPAC, 24 Hanley Industrial Ct., St. Louis* 17.

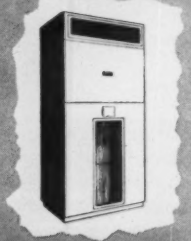
▸ *BOILERS*—Recently issued catalog describes new model of manufacturer's Scotch type boiler. "Full wet back sides and top" design is illustrated, as well as new arrangement of pressurized smoke box and furnace extensions. Specifications of 16 sizes given in table. *Fitzgibbons Boiler Co., Inc., Dept. HPAC, 101 Park Ave., New York* 17.

▸ *CABINET HEATERS*—New, 16 page, illustrated catalog (bulletin 9617) describes construction features of redesigned line of cabinet heaters. Pictorial guide shows 43 possible mountings; tables of steam capacities for 14 models, and hot water capacities for 21 models also included. Supplementary data includes Btu correction factors for hot water and steam, cfm conversion factors, correction factors based on external resistance, AMCA classifications for sound level. Schematic drawings illustrate four conventional piping installations for cabinet heaters. *American Blower, Div. of American Standard, Dept. HPAC, Detroit* 32.

▸ *COLOR CODED COPPER TUBE*—Full color display card now available for identification of company's copper water tube line. Card identifies by letters and colors five types of copper tube usually used in heating and piping work: K, L, M, DWV, and TP tube. *Chase Brass & Copper Co., Dept. HPAC, 236 Grand St., Waterbury* 20, *Conn.*

▸ *CONTROLLED SPEED SYSTEMS*—New, illustrated booklet describes typical installations for controlled automatic variable speed systems application. Information provided on determining preliminary planning, obtaining maximum efficiency. Systems applicable to basic handling processes, e.g., mixing, filtering, conveying, proportioning. *U. S. Electrical Motors, Inc., Dept. HPAC, P. O. Box* 2058, *Los Angeles* 54.

THE LEADER IN REFRIGERATION SINCE 1882



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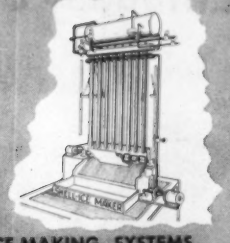

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● CONDENSERS
● AIR COOLING UNITS
● CONTROLS, VALVES & FITTINGS

● ICE-MAKING SYSTEMS
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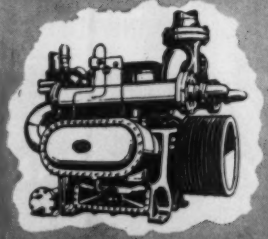
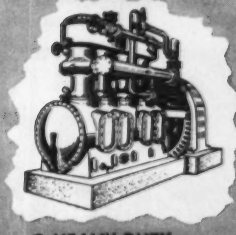
● QUICK-FREEZING SYSTEMS
● LOW PRESSURE REFRIGERATION UNITS





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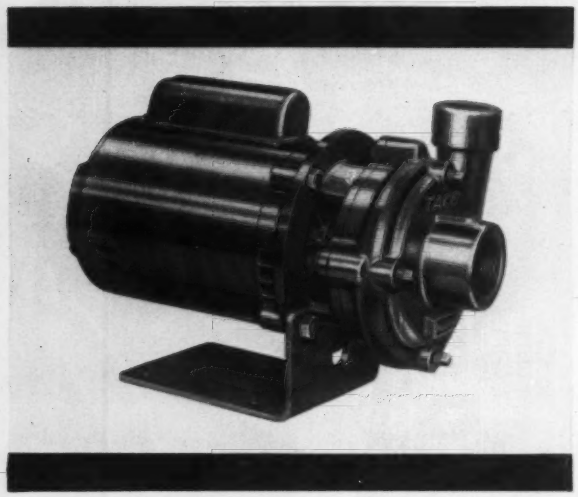
A MULTI-PURPOSE, POWER PACKED CENTRIFUGAL PUMP

TACO 170



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RECENT TRADE LITERATURE

Continued

▸ *CYLINDER ACTUATORS*—Recently issued bulletin B-50-3 describes company's line of cylinder actuators for valves, pumps, variable speed drives. Included are operating details, suggested applications, such as proportional control of different types of valves, speed changers, pumps, rheostats, automatic transformers, flow regulators, others. Diagrammed and illustrated. *Conoflow Corp., Dept. HPAC,* 2100 *Arch St., Philadelphia* 3.

▸ *ELECTRIC DUCT HEATERS*—Newly revised, illustrated, 20 page bulletin E-97U describes application, construction, features of company's line of heaters, especially adaptable for use with air conditioning systems. Construction, components illustrated. Schematic wiring diagrams included. Specifications and operational data given in tables. *Industrial Engineering and Equipment Co., Dept. HPAC,* 24 *Hanley Industrial Ct., St. Louis* 17.

▸ *ELECTRODE SELECTION*—New 12 page "weldirectory" No. 7000.1 tells how to select most efficient electrode for particular welding job. Basic characteristics of each family of electrodes described, giving deposition, arc action, amount of slag, bead appearance, general applications. Individual electrodes within family are differentiated, with physical properties, current ranges, sizes, welding procedure for each electrode. Wall chart supplied giving information on company's line of electrodes. *Lincoln Electric Co., Dept. HPAC,* 22801 *St. Clair Ave., Cleveland* 17.

▸ *EVAPORATIVE CONDENSERS*—New 16 page engineering manual explains theory and application of evaporative condensers, from basic design through installation and refrigerant piping hookup. Schematic drawings, charts, graphs, tables illustrate text. *Baltimore Aircoil Co., Inc., Dept. HPAC, P.O. Box* 7322, *Baltimore* 27.

▸ *FEEDWATER REGULATOR*—Thermohydraulic type regulators for control of feed water to small boilers are described in new, 4 page brochure M85-1. Construction, operation, dimensions provided. Illustrations, cutaway drawings, diagrams also included. *Bailey Meter Co., Dept. HPAC,* 1050 *Ivanhoe Rd., Cleveland* 10.

▸ *HEATING CONTROLS*—Condensed, 1958 catalog of heating, air conditioning controls now available. New listings include: "Series 872X" line voltage heating, cooling thermostats; "Series 932" gas appliance pressure regulator; triple function hot water control

RECENT TRADE LITERATURE *Continued*

also shown. Thermostat heater information guide also featured. *Penn Controls, Inc., Dept. HPAC, Goshen, Ind.*

▸ *HIGH VELOCITY SYSTEMS*—Recent 52 page catalog TA-100 gives engineering, performance data on 19 types of "Thermotank-Agitair" high velocity units, available in 106 sizes for ceiling, perimeter, interior zone air conditioning systems. Dimensional drawings, tables of dimensions for each type included. Duct design, typical system layouts, installations illustrated. *Air Devices Inc., Dept. HPAC,* 185 *Madison Ave., New York* 16.

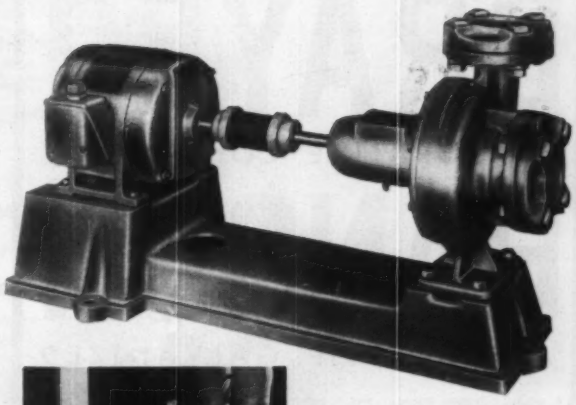
▸ *HOT GAS WASHER*—Single unit, said to eliminate most air pollution problems and resist temperatures up to 2000 F, described in 4 page bulletin L-2 now available. Text describes operational details, features; isometric drawing illustrates unit's operation. Complete specifications for seven models given. *Lehigh Fan & Blower Div., Fuller Co., Dept. HPAC, Catasauqua, Pa.*

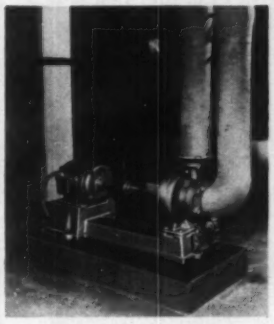
▸ *HYDRAULIC TOOLS*—Recent 8 page catalog (form 8-420) describes three basic hydraulic units. Operating characteristics, information relating to styles, types, subassemblies given. Listing of fasteners installed by each tool also included. *Huck Mfg. Co., Dept. HPAC,* 2840 *Bellevue Ave., Detroit* 7.

▸ *INDUCTION MOTOR*—Recently published 8 page bulletin No. 1900 describes company's "Synchro-Spede" synchronous induction motor, which is said to be first such motor built in same NEMA frame size as standard motor of equal hp in ratings 1 to 100 hp. Graphs, text outline principles enabling motor to accelerate as induction motor, run at exact synchronous speed without permanent magnets or d-c excitation involving collector rings and brushes, wound rotating fields, etc. *Louis Allis Co., Dept. HPAC,* 427 *E. Stewart St., Milwaukee* 1.

▸ *LIQUID FLOW METERS*—Diagrammed, illustrated bulletin No. 380-L3A D describes company's line of secondary instruments, accessory devices available for changing "Builders-Providence Propeloflo Meter" from basically totalizing unit to one suitable for combination of remote totalizing, indicating, recording functions, batch measurement of liquid flows. Specifications, capacity charts, other data included. *B-I-F Industries, Inc., Dept. HPAC,* 345 *Harris Ave., Providence* 1, *R.I.*

TACO MP SERIES PUMP





For quiet, vibrationless operation and rugged dependability on large installations

Designed specifically for heating and cooling systems requiring quiet, smooth operation, the new Taco MP series pump offers a host of outstanding features:

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- A spring drive coupling which easily absorbs starting torque and designed for quiet operation.
- A long-life impeller shaft of stainless steel, hardened and ground to a mirror finish.
- Bronze bearings in bracket, separated by a thrust collar attached to the shaft, absorb all end thrust.
- An oil bath circulating system with modern slinger rings, lifts oil to both bronze bearings.
- Bearing bracket, impeller and shaft are completely removable without disturbing motor, volute or piping connections.
- A closed type impeller of bronze or cast iron, dynamically balanced for smooth noiseless operation and designed to eliminate hydraulic thrust.
- Volute on body legs bolted directly to the base prevent piping strains from changing pump alignment.
- A base of cast iron designed with a three-point floor mounting to simplify leveling. Provision is also made to fill with concrete for sound deadening.

For the features that mean a better performance for every large hot water heating or cooling system, put the new Taco MP series pump on the job!

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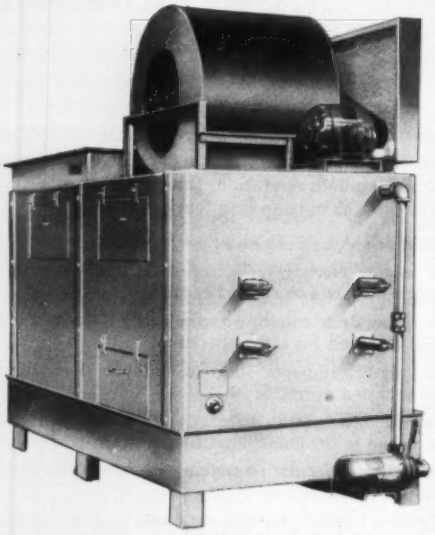

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RECENT TRADE LITERATURE

Continued

▸ *PYROMETERS*—Catalog No. 175 contains descriptive and technical data on manufacturer's line of "Pyro" optical, micro-optical, radiation, immersion, surface, indicating pyrometers. Illustrations, specifications of all models included. *Pyrometer Instrument Co., Inc., Dept. HPAC, Bergenfield, N.J.*

▸ *RADIANT ACOUSTICAL CEILING*—Recent 4 page brochure A.I.A. File No. 30-C-44 explains manufacturer's radiant-acoustical ceiling, with radiant panel used in conjunction with standard acoustical tiles for radiant heating, cooling, noise reduction. Description of components given; schematic illustration of installation of ceiling also included. *Airtex Corp., Dept. HPAC, 2900 N. Western Ave., Chicago* 18.

▸ *RELIEF VALVES*—Company's line of water system relief valves described in 4 page bulletin LL-5990. Two models, "451" and "452," for pressure-only protection in cold and hot water lines, are listed, together with three models, "453, 494, 495," for both temperature and pressure relief. Each valve has special internal construction, permitting replacement of bibb washers without removing entire valve from line, according to manufacturer. Also included in features: stainless steel control spring located within red brass valve body. *Mansfield Sanitary, Inc., Dept. HPAC, Perrysville, Ohio.*

▸ *SCHOOL HEATING*—Manual on schoolroom packaged heating, ventilating systems presents requirements for classroom installations, shows how company's line fills these requirements. Various applications of warm air, perimeter system presented in manual. Component parts of gas fired individual central heating unit, air distribution systems illustrated, described. Architectural and mechanical data, engineering drawings included. *Norman Products Co., Inc., Dept. HPAC, 1150 Chesapeake Ave., Columbus, Ohio.*

▸ *SCHOOL HEATING-VENTILATING UNITS*—Special catalog describes company's line of "Torrivent" heating, ventilating units for school applications in gymnasiums, auditoriums, cafeterias, libraries, others. Intended primarily for engineers, architects, school board members concerned with school construction, catalog contains complete sales, data information. Components illustrated, described; dimensions provided; sample engineering specifications listed. Available in 1, 2, 3 fan units, with air deliveries from 1250 to 17,000 cfm, heating capacities from 50,000 to 2,000,000 Btu per hr. *Trane Co., Dept. HPAC, La Crosse, Wis.*

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Low cost — The Van-Packer Industrial Stack is made of prefabricated sections for economy and easy installation. It costs no more than a steel stack, yet lasts substantially longer. Costs only a third as much as a brick stack.

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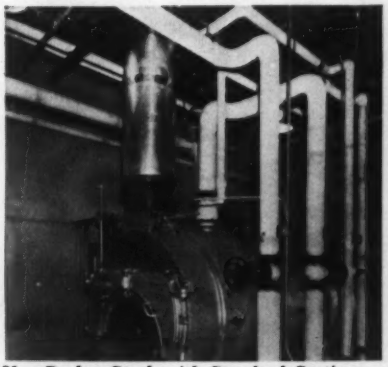
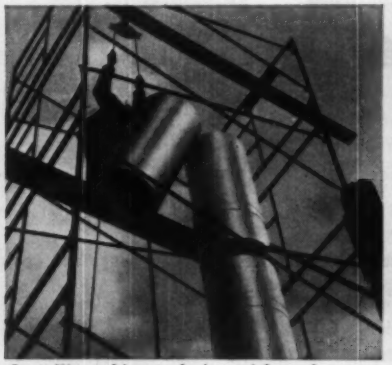
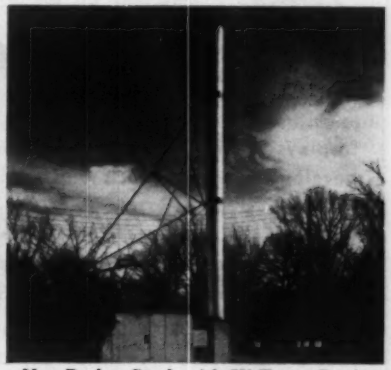


Van-Packer Stack with Standard Sections handles boilers and furnaces efficiently. Can be superimposed or floor supported.



Installing this stack is quick and easy. Three-foot sections are simply cemented atop one another with acidproof cement.



Van-Packer Stack with Hi-Temp Sections handles industrial incinerators with flue gas temperatures up to 2000° F.

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RECENT TRADE LITERATURE

Continued

▸ *STEEL SHEETS*—Revised technical bulletin 11-2 serves as buyer's guide to hot rolled steel sheets and strip, listing products that may be combined for savings in cost, according to company. Cutting services illustrated and described, with specification details, size ranges. *Joseph T. Ryerson & Son, Inc., Dept. HPAC, Box 8000-A, Chicago 80.*

▸ *STEEL TUBING*—Illustrated, 16 page booklet TB-417 gives information on application of tubing, pipe, welding fittings. Included are application data, material selection information, analysis, physical mechanical and creep strength properties of various steels. All popular analyses from carbon steel through stainless steel titanium given. *Babcock & Wilcox Co., Tubular Products Div., Dept. HPAC, Beaver Falls, Pa.*

▸ *SUBMERSIBLE PUMPS*—New catalog details company's line of industrial submersible pumps, with illustrated applications of use. Physical dimensions, pumping capacities, electrical data, specific features of each pump included. *Kenco Pump Div., Dept. HPAC, 1309 Oberlin Ave., Lorain, Ohio.*

▸ *TRAP MAINTENANCE*—Reprint available of illustrated, 2 page article by Ralph C. Bellas, "Something New in Trap Maintenance," describing way of detecting faulty steam traps. Method is based on use of company's "Tempilstik" temperature indicating crayons to discover whether or not temperature of return line below trap is lower than temperature of steam supply line above trap. Same temperature above and below indicates defective steam trap. *Tempil Corp., Dept. HPAC, 132 W. 22nd St., New York 11.*

▸ *VITRIFIED CLAY PIPE*—New 4 page bulletin describes vitrified clay pipe, other products. Literature contains installation data, specifications, dimensions for "Wedge-Lock" clay pipe, extra-strength vitrified clay pipe; "Slip-Joint" clay pipe; clay flue lining; ventilator caps. Fully illustrated. *Robinson Clay Product Co., Dept. HPAC, 65 W. State St., Akron 9.*

▸ *WATER HEATERS*—Booklet gives information on application, selection, installation of indirect type instantaneous water heaters. Units obtain heat from same hot water or steam boiler that furnishes heat for building. Illustrations, charts, diagrams, data tables included. *Bell & Gossett Co., Dept. HPAC, Morton Grove, Ill.*

▸ *WELDING FITTINGS*—Illustrated, 4 page folder No. FB-504 outlines procedures in pipe welding, with tips on dimensional accuracy. List of company's line of fittings, tubular products and extrusions included. *Babcock & Wilcox Co., Tubular Products Div., Welding Fittings Dept., Dept. HPAC, Milwaukee 46.* ∓

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WHO'S WHAT...

(New personnel, promotions)

▸ *BUENSOD-STACEY, INC.*—R. O. McGary, senior vice president, transferred to New York.

▸ *BOHN ALUMINUM & BRASS CORP.*—Guy H. Pitts, vice president of manufacturing.

▸ *SPRAY ENGINEERING CO.*—John S. Hartley, president; John J. Aprea, first vice president; Frank L. Stoughton, second vice president.

▸ *TUBE TURNS, DIV. OF NATIONAL CYLINDER GAS CO.*—Thomas H. Pike, Jr., vice president—planning; John E. Chumbley, vice president—general sales operations.

▸ *ARMSTRONG CORK CO.*—Albert H. Sheaffer, secretary of the company.

▸ *HOLMES & NARVER, INC.*—Thomas W. Burtt, vice chairman of the board; David L. Narver, Jr., vice president—engineering; D. C. Van Dine, vice president—construction; Charles B. Roen, vice president; Maynard R. Born, assistant vice president.

▸ *ROBINSON CLAY PRODUCT CO.*—A. E. Williams, elected to board of directors.

▸ *RIDGE TOOL CO.*—Carl H. Ingwer, founder and former president, elected chairman of the board; Joseph A. Frates, president and general manager; Henry J. Freas, treasurer and assistant secretary, elected to the board of directors.

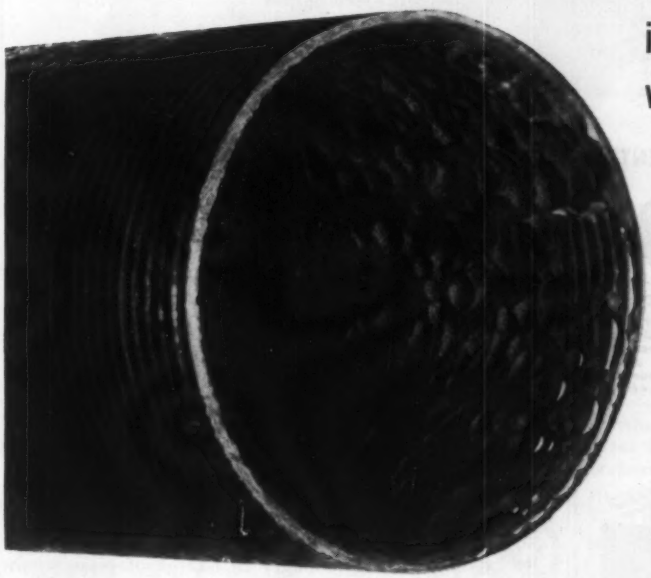
▸ *V. C. PATTERSON & ASSOCIATES, INC.*—J. V. Masterman, special consulting engineer for proposed meat packing plant project in Tehran, Iran.

▸ *BLACK & DECKER MFG. CO.*—J. Early Hardesty, vice president—treasurer; George W. McCarty, vice president—research and development.

▸ *UTILITY APPLIANCE CORP.* and *MISSION APPLIANCE CORP.*—P. L. Chabre, vice president, sales and marketing.

▸ *AMERICAN WATER SOFTENER CO., INC.*—Alfred G. Scattergood, president; Alfred G. Zeigler, vice president and general manager; Martin H. Love, Jr., vice president—production and procurement; George S. Garrett, treasurer; Richardson Blair, secretary.

control condensate corrosion



An example of pipe after attack by condensate corrosion.

increase heat transfer—reduce maintenance with HAGAFILM®

Hagafilm, the safe filming amine, forms a non-wettable film on all metal surfaces, including copper and its alloys. Fed to the boiler, to the feedwater, or directly to steam lines in economical quantities (2 to 3 lbs. per 1,000,000 lbs. of steam), Hagafilm forms a thin, tough coating which controls corrosion. Its non-wettable character promotes dropwise condensation which can increase heat transfer.

Hagafilm is available in both solid and liquid forms and is safe to handle and use. Hagafilm cleans out old corrosion deposits, reduces maintenance costs and keeps valves, traps and pumps at top efficiency.

Write for free bulletin. Learn how Hagafilm can save money and time in every operation where steam is used.

HAGAN CHEMICALS & CONTROLS, INC.

HAGAN BUILDING, PITTSBURGH 30, PENNSYLVANIA
DIVISIONS: CALGON COMPANY, HALL LABORATORIES
IN CANADA: HAGAN CORPORATION (CANADA) LIMITED, TORONTO

"SP-7" 7-blade semi-pressure DUCT FANS

Installed at the Columbus, Ohio plant of North American Aviation, Inc., new Aerovent "SP-7" Belt-Driven Duct Fans, with 7-blade "Macheta" Airfoil Propellers, remove acrid fumes and vapors from a spray-type processing machine. At temperatures of 180° to 200° F., the solution flashes into steam and noxious fumes which would contaminate the entire area if unabated. Located above each end of the spray section, and at intermediate points, the fans induce a steady flow of air through the unit to trap and remove heavy vapors at their source.

Recommended for resistances in the ¾" to 2½" S.P. range, these units, designed for all standard duct systems, move *more air* with less horsepower; provide greater mechanical efficiency with lower initial and operating costs. May be ordered with special-duty motors, alloy propellers and special protective coatings for extreme temperature, moisture or corrosive conditions.

WRITE FOR FREE BULLETIN NO. 400

"SP-7" FANS FOR ALL INDUSTRIAL REQUIREMENTS

DIRECT CONNECTED
Steel ring or square panel for wall, ceiling or penthouse. 14" to 60". Used with extended shaft for heat, moisture or corrosion.

DIRECT-DRIVEN DUCT
For installations which permit connection of entire fan assembly in air-stream. For vertical or horizontal use. 14" to 60".

"BI-FLO" DUCT
New divided-duct design, for air-supply or exhaust. Motor located out of airstream. Also serves as stack booster. Sizes 18" to 48".

"EFFICIENCY-ENGINEERED" equipment for every air-handling problem!

Aerovent

Rated in accordance with Standard Test Code and U.S.D.C. Comm. Std. CS178-51.

Certified Ratings

Aerovent FAN CO. INC.

Ash and Branch Sts — Piqua, Ohio

WHO'S WHAT — *Continued*

▸ *EMBASSY STEEL PRODUCTS, INC.*—Irwin B. Nelson, vice president—national sales.

▸ *FLEXONICS CORP.*—Donald F. Ghent, secretary of the company.

▸ *TRION, INC.*—Dick S. Ashcom, Jr., treasurer.

▸ *H. K. PORTER CO., INC.*—Burton Schnellenbach, vice president—sales.

▸ *MUELLER BRASS CO.*—Orville R. Payton, director of sales promotion and advertising.

▸ *WEIL-McLAIN CO.*—Paul T. Stracke, advertising manager.

▸ *PITTSBURGH CORNING CORP.*—Robert E. Buckley, general sales manager.

▸ *AJAX FLEXIBLE COUPLING CO., INC.*—Thomas H. Brumagin, general sales manager.

▸ *X LABORATORIES, INC.*—George I. Klein, sales manager of company's heating and plumbing line.

▸ *PENN CONTROLS, INC.*—James F. Kinney, director of company's new industrial sales division.

▸ *DOWNINGTOWN IRON WORKS, INC.*—W. L. Killen, executive vice president.

▸ *CHASE BRASS & COPPER CO.*—Henry C. Ashley, metallurgical director at company's plant.

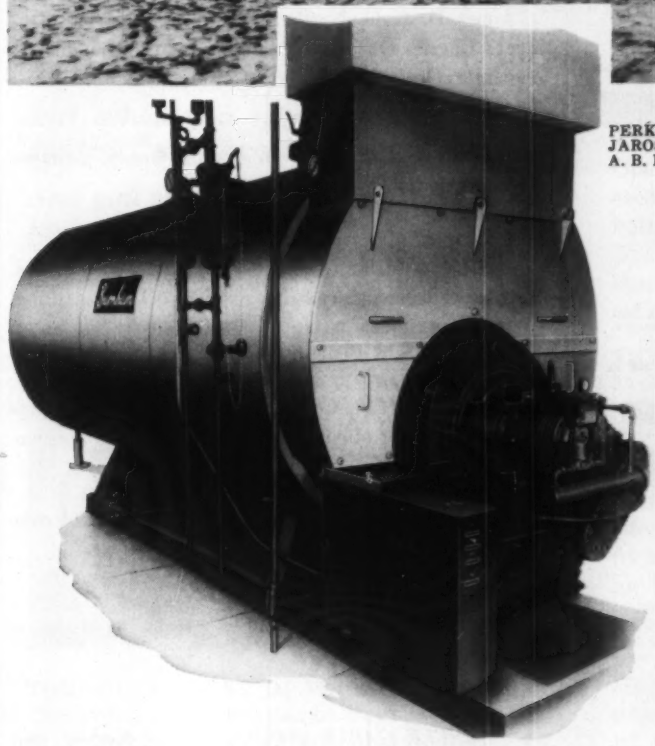
▸ *MINNEAPOLIS-HONEYWELL REGULATOR CO.*—W. T. Gove, market sales manager of company's automatic control sales in office building field; W. T. Ortman, market sales manager for company's automatic control sales to industrial buildings and the maritime industry.

▸ *DRESSER MFG. DIV., DRESSER INDUSTRIES, INC.*—John T. Dunton, engineering manager in charge of pipe joining products and service fittings; Howard Hoke, engineering manager in charge of pipe repair products; Thomas O' Hargan, customer service engineer.

MODERN HEATING for a MODERN SCHOOL

Edgewood Elementary School, Scarsdale, New York

PERKINS & WILL ..... *Architects — White Plains, New York*
JAROS, BAUM & BOLLES .. *Consulting Engineers — New York City*
A. B. BARR & CO. ..... *Heating Contractors — Yonkers, New York*



Stock Boilers both "Compact" and "Scotch Type" are available for prompt shipment.

Scarsdale School heats with BURNHAM Packaged Scotch Type Boilers

Up-to-date in every detail of equipment, the Edgewood Elementary School uses two BURNHAM Packaged "Scotch Type" Steel Boilers for efficient heating. Another Scarsdale elementary school, Greenacres, also uses the same design of heating plant and BURNHAM Boilers. These give outstanding performance and economy for good reasons. A carefully engineered and designed Scotch Type Boiler to S.B.I. Ratings — Built to and exceeding ASME Code Construction together with a proven Burner make this a perfectly matched team. BURNHAM "Scotch Type" Package Boilers can be supplied to you in capacities of 2,600 to 35,000 sq. ft. E.D.R. steam and 4,680 to 56,000 sq. ft. E.D.R. water, net S.B.I. ratings.

Burnham Corporation

Steel Boiler Department
Irvington, New York

MEMBER S.B.I.

Sales Representatives throughout the U.S.A.

Burnham Corporation HP-48
Steel Boiler Dept.
Irvington, New York

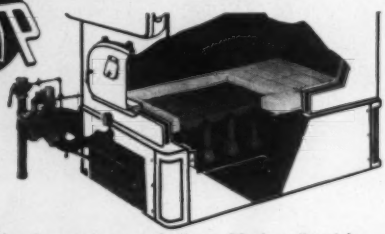
Please give me, without obligation, full ratings and data on:
Scotch Type Boilers ☐ Boiler-Burner Packages ☐ Compact Boilers ☐

Name .....

Address .....

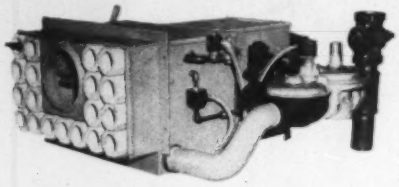
City ..... State .....

"Planned Performance"*
BURNERS



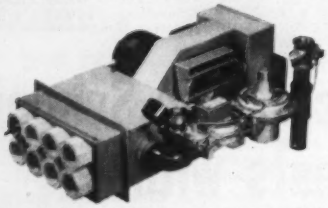
For heating and power boilers. 23 sizes listed in Catalog No. A-10.

BLUE LINE UPSHOT ATMOSPHERIC GAS BURNER



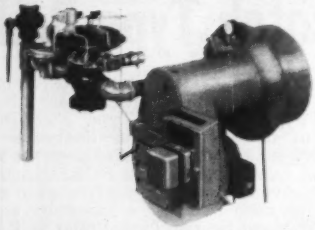
Retracted oil nozzle on gas firing. Sizes up to 30 GPH light oil. Catalog E-30.

DUO-FLAME COMBINATION GAS-OIL BURNER



Fully automatic, forced draft. Sizes listed to 28 million BTU/HR in Catalog C-10.

TURBO-FIRE POWER TYPE GAS BURNER



No stack required on boilers equipped for pressure firing. Sizes up to 10 million BTU/HR in Catalog C-15.

SCOTCH MARINE TYPE FGR PRESSURE BURNER

* PLANNED — Factory assembled, pre-wired for "Bolt-in" installation.

* PERFORMANCE — Custom matched to individual boilers for quiet, efficient operation.

Gordon & Piatt also manufacturer of a complete line of domestic conversion burners plus large dual-fuel units. Write for literature and complete information.

Gordon & Piatt
P. O. Box 914
Winfield, Kansas

WHO'S WHAT

Continued

▸ *WARREN WEBSTER & CO.*—A. Richard Webster, named "Young Man of the Year" by the Greater Camden Junior Chamber of Commerce.

▸ *CARRIER CORP.*—William E. Hood, assistant manufacturing manager; Karl M. Gerteis, development department manager; Theodore Foster, manager of compressor product engineering; William LaGrange, manager, automatic ice maker product engineering; Edward Burke, section engineer; Paul Britton, senior development engineer.

▸ *F. E. MYERS & BRO. CO.*—Roger Barron, submersible marketing manager.

▸ *METALBESTOS DIV., WILLIAM WALLACE CO.*—James D. Kyle, Northern California district manager; Charles Q. Griffin, Southern California district manager; John H. Eiseman, consultant.

▸ *BURNS & ROE, INC.*—William J. Grady, manager of construction.

▸ *ALLIS-CHALMERS MFG. CO.*—E. F. Greiwe, manager of company's Norwood Works centrifugal pump department.

▸ *A. O. SMITH CORP.*—Ralph Heindl, Chicago branch manager of company's product service division.

▸ *SQUARE D CO.*—Hugh Brunner, manager of company's assembly plant in Cedar Rapids, Iowa.

▸ *RECOLD CORP.*—Harold A. Halls, manager of refrigeration products.

▸ *CHESTER CABLE CORP.*—Richard Kerney, general production manager.

▸ *KEASBEY & MATTISON CO.*—Bradfield Scranton, industrial relations manager; Alan F. Nagle, manager of company's tubular products and sewer pipe sales department; Frederick L. Bickel, section leader of insulation division; John B. Mills, field engineer in asbestos-cement pipe division.

▸ *DE LAVAL STEAM TURBINE CO.*—Dr. Karol Pilarczyk, director of research and development.

New information for engineers about the lowest-cost air conditioning of all . . .

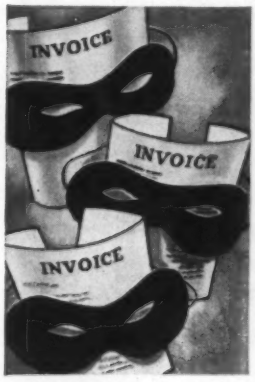
How CHRYSLER'S AIRTEMP controls

The 3 "Secret Costs" of Air Conditioning

"Secret Costs" can quickly amount to more than original cost...

But, when you specify AIRTEMP, you control "secret costs"

And you give your clients a brand they know—and trust.



No matter what kind or size of installation your plans call for, Chrysler AIRTEMP makes it . . . and you pay no more for it.

But the important fact is this: Chrysler AIRTEMP costs your client *far less* in the long run because it minimizes the 3 "secret costs" of air conditioning. And these may be more important than the first cost!

THE SECRET COST OF WRONG EQUIPMENT
The wrong equipment can be troublesome as well as costly to operate. Airtemp makes all kinds of air conditioners—over 297 models—and can advise you on which is best for your client's needs. You're sure to get exactly the right equipment from Airtemp!

THE SECRET COST OF OPERATION
Operating costs over a few years may actually exceed the first cost of air conditioning. But rock-bottom operating costs can save substantial sums. That's why you should know that AIRTEMP—thanks to Chrysler engineering—promises the lowest operating costs in the industry!

THE SECRET COST OF MAINTENANCE
Maintenance costs and repair costs can be a shock. A breakdown brings repair bills PLUS the cost of lost time, lost business. But Airtemp air conditioning is carefully engineered by Chrysler for trouble-proof operation. And Airtemp is installed only by qualified contractors, who must certify to Airtemp that equipment, warranted for 5 years, has been installed properly. That's why Airtemp maintenance costs average out to be the lowest in the industry!

May we give you the complete facts? For prompt action mail the coupon below. Or phone your nearest Airtemp contractor or dealer who is listed in the Yellow Pages.

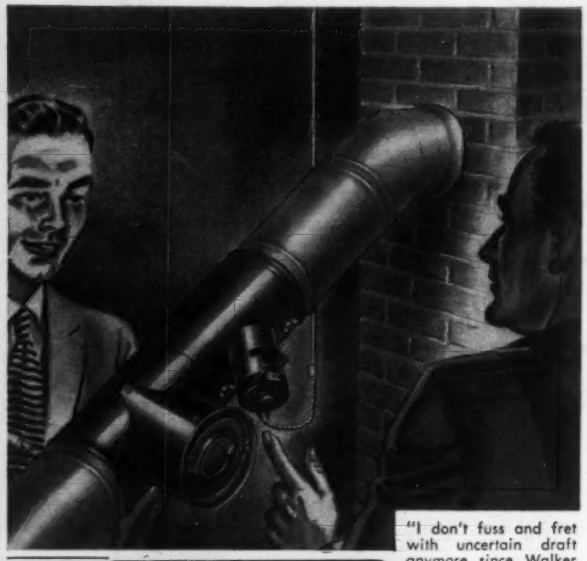
CHRYSLER

Airtemp

AIRTEMP DIVISION, CHRYSLER CORP.
Dayton 1, Ohio
We would like the full facts on how Airtemp controls the 3 "secret costs" of air conditioning.

Name_____
Address_____
City_____ Zone____ State_____
Firm Name_____

"Sure! This Walker Unit Ends All My Draft Problems"



"I don't fuss and fret with uncertain draft anymore since Walker brought out this low-priced draft inducer-regulator combination. Now, I install Walker inducers on all my jobs. That puts me way out ahead, because with good draft I know every job will be exactly right from the start.

WALKER
SHUR - FLO
Draft Inducer-Regulator

"Most Efficient Draft Control System Ever Made"

Say Heating Contractors, Architects, Builders & Home Owners

Here's an economical answer to every draft problem from older heating installations to modern, low-roofed houses. The new Walker Shur-Flo (Pats Pending) is the surest draft system ever devised – and the most economical. Walker's fan operated draft inducer moves ONLY flue gases ... does not suck in outside air. No wonder it runs quieter, costs less, requires less power. Walker does a complete job of inspirating draft and controlling excess draft. Models available for oil, gas, and coal fired installations.

Perfect for modern homes whose lower chimney heights present a draft problem, the new Walker Shur-Flo is popular with heating contractors and builders because it installs quickly at any angle – vertically, horizontally or at a pitch. Economical in cost, it is highly profitable since it virtually eliminates costly call-backs and corrections. The carefully balanced propeller type fan and small but sturdy motor assure quiet trouble free operation, free from vibration.

For full details see your supplier or write direct.

Other Famous Walker Draft Controls serving 25,000,000 Users.

Royal Purple | Walker Junior Line | Walker Gas Double Swing | Walker Chimney Cap

WALKER MFG. AND SALES CORP.
1720 Penn St., St. Joseph, Mo.

WHO'S WHAT

Continued

▸ *ORR & SEMBOWER, INC.*—William P. Williams, product manager for fuel burning systems and packaged automatic boilers; William B. Firman, marketing manager; Robert C. Gray, assistant marketing manager.

▸ *McINTIRE CO.*—Stanislaw Witkowski, research and development engineer.

▸ *PHILIP CAREY MFG. CO.*—Paul D. Japp, assistant executive vice president.

▸ *HAYS CORP.*—Mats-Olaf Macklin, liaison development engineer.

▸ *ROBERTS-GORDON APPLIANCE CORP.*—William L. Wright, Jr., assistant general sales manager.

▸ *INTERNATIONAL NICKEL CO., INC.*—Dr. Joseph V. Petrocelli, head of the electrochemical section.

▸ *SOUTHERN UNION GAS CO.*—Maurice L. Carlson, utilization manager.

▸ *HUPPOWER DIV., HUPP CORP.*—William H. Walter, manager of division's new market research department.

▸ *AIR-MAZE CORP.*—John Clem, sales manager.

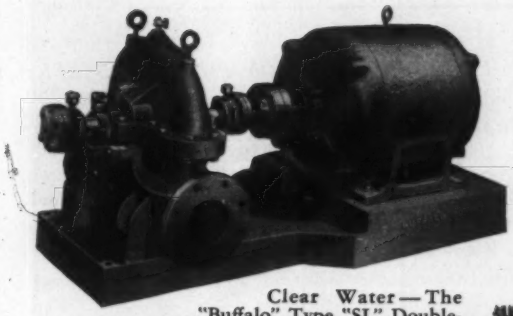
IN THE TERRITORIES . . .

(Recent sales appointments)

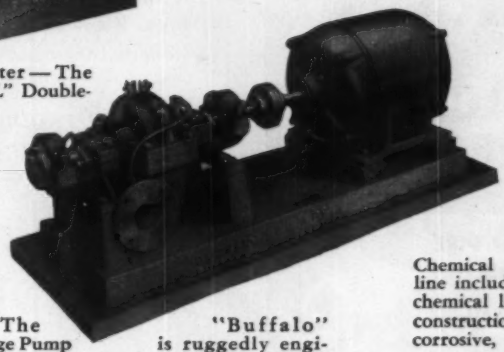
▸ *NIAGARA MACHINE & TOOL WORKS* — George M. Meriwether, Inc., distributor in Alabama, northwestern Florida.

▸ *CHROMALOX COMMERCIAL SPACE HEATING DIV., EDWIN L. WIEGAND CO.* — Robert Lee Boyd, Jr., promoter of electric space heating in schools, commercial, industrial applications.

▸ *MANNING, MAXWELL & MOORE, INC.*—Robert L. Logan, sales manager for the mid-continent district out of Tulsa; Lamar F. Kirby, manager of the southeast sales district, with headquarters in Atlanta; Arthur H. Barnes, district manager for the Pacific Coast, headquarters in Los Angeles.

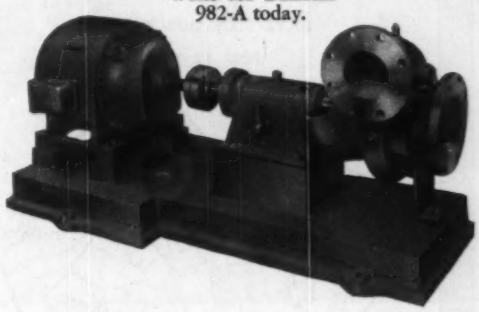


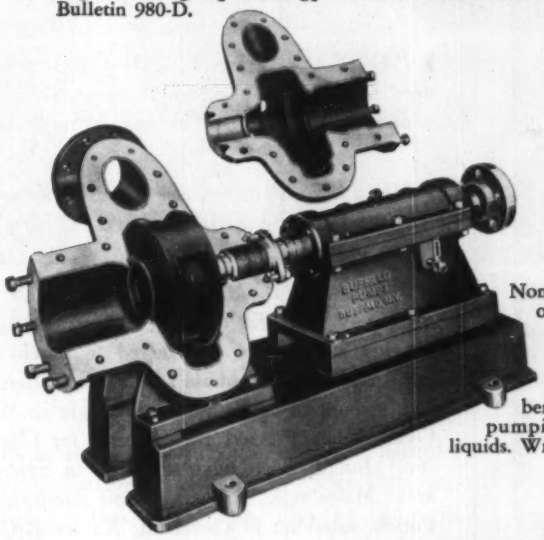
Clear Water — The "Buffalo" Type "SL" Double-Suction Pump is recognized for its highly efficient clear water service throughout industry. Capacities from 10 to 14,000 gpm. Write for Bulletin 955-R.



High Pressure — The "Buffalo" Type "RR" Multi-Stage Pump is ruggedly engineered to deliver peak efficiency on boiler feed and other clear water applications against heads as high as 1500 feet. Capacities range up to 900 gpm. For full details write for Bulletin 980-D.

Chemical Liquids — The complete "Buffalo" line includes ten specially designed pumps for chemical liquids. Available in several types of construction for handling a wide variety of corrosive, abrasive or high-consistency liquids. Write for Bulletin 982-A today.





Non-Clogging — "Buffalo" Diagonally Split-Shell Pumps are designed for moving high-consistency liquids, with down-time reduced to an absolute minimum. A number of models are available for pumping abrasive and corrosive liquids. Write for Bulletin 953-K.

WHATEVER YOUR LIQUID-MOVING PROBLEM, THERE'S PROBABLY A "BUFFALO" PUMP TO SOLVE IT!

And the fact that "Buffalo" builds a *complete line* of pumps — a type, size and capacity to fit almost every liquid-moving need — can save you money right from the start. It means you never need to pay for "more pump" than you actually require.

You'll find a "Buffalo" Pump to match your exact requirements, with complete assurance of the utmost efficiency, dependability, ease of maintenance and long-range economy. Just contact your nearest "Buffalo" engineering representative, or write us direct. We'll be glad to recommend the pump that's best-suited to your needs.

THE COMPLETE "BUFFALO" LINE ALSO INCLUDES: Heat Transfer Pumps, Close-Coupled Pumps, Sump Pumps and Raw Sewage Pumps. Special alloys available in all models.

Engineered into every "Buffalo" Pump is the famous "Q" Factor — the built-in QUALITY which provides trouble-free satisfaction and long life.

BUFFALO PUMPS
DIVISION OF BUFFALO FORGE CO.
171 Mortimer St. • Buffalo, N. Y.
Canada Pumps Ltd., Kitchener, Ont.
Sales Representatives in All Principal Cities
A BETTER CENTRIFUGAL PUMP FOR EVERY LIQUID

"WITCH"

PIPE HANGERS

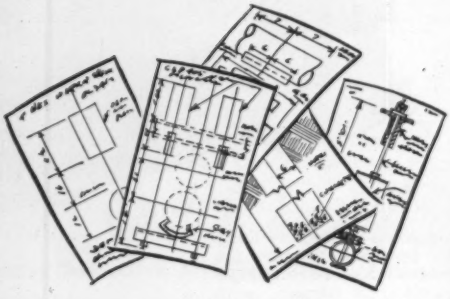
FOR

HEATING – PLUMBING
POWER & PROCESS

GOT A TOUGH PIPE
HANGING PROBLEM?

FORGET IT!!!

YOUR TOUGH PROBLEMS
HAVE BEEN OUR BUSINESS
FOR 42 YEARS



OUR ONLY BUSINESS IS
FABRICATION & DESIGN OF
PIPE HANGERS AND SUPPORTS

Our catalogue illustrates a complete line of Pipe Hangers & Supports and is an indispensable reference book for engineers, contractors, estimators & erectors. Write for your copy now.

MAINTAINING OFFICES AND WAREHOUSES
ACROSS THE NATION

CARPENTER and PATERSON, Inc.

18 HURLEY ST., CAMBRIDGE, MASS.

WHO'S WHAT

Continued

▸ *ST. LOUIS AND HOUSTON PIPE AND STEEL, INC.*—Robert O. Ayres, Jr., regional sales representative in the Gulf Coast area.

▸ *KEROTEST MFG. CO.*—R. D. McCrady Sales Co., territorial assignment extended from Missouri, Kansas, Iowa, Nebraska, to include southern Illinois and southwestern Indiana.

▸ *FREON PRODUCTS DIV., E. I. DU PONT DE NEMOURS & CO.*—William F. Kelly, office manager for eastern district office in New York City.

▸ *BUENSOD-STACEY, INC.*—Fontanesi & Kann Co., Michigan area sales of dual-duct air mixing equipment for commercial, industrial air conditioning.

▸ *JOHN J. NESBITT, INC.*—A. J. Vekony, manager of new factory sales office in greater Cleveland area.

▸ *PAYNE CO.*—Kenneth E. Hill, factory sales engineer for southern California area, serving San Fernando Valley and west Los Angeles territories.

▸ *MUELLER BRASS CO.*— L. C. Lucas, sales representative, assigned to Melrose Park, Ill., office.

▸ *WATERBURY MFG. CO., DIV. OF CHASE BRASS & COPPER CO.*—Six members of company's division sales office transferred to parent organization's mill and warehouse sales organization; Thomas J. Marshall, to company headquarters in Waterbury, Conn; Kenneth A. Irons, salesman for Chicago division; Joseph F. Kenny, salesman in San Francisco area; Malcolm K. Palmer, Detroit salesman; William Putich, salesman in Cleveland; Xavier J. Galgota, to sales headquarters in Waterbury.

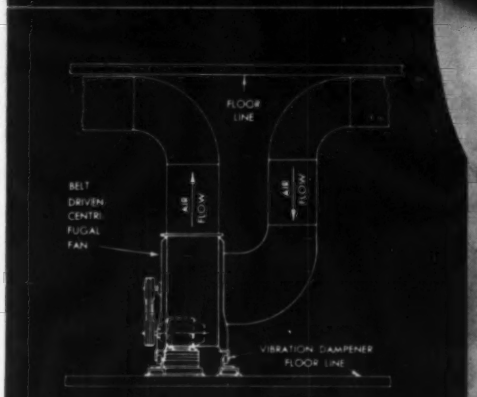
▸ *RECOLD CORP.*—Kleinman Bros., Inc., Baltimore, wholesale distributor for company's air conditioning, refrigeration products.

▸ *AUTOMATIC SWITCH CO.*—Electrical Engineering & Equipment Co., Des Moines, new distributor of solenoid valves; Industrial Equipment Co. of Houston, distributor of electromagnetic controls in Houston area; Burns Bros., Syracuse distributor of solenoid valves.

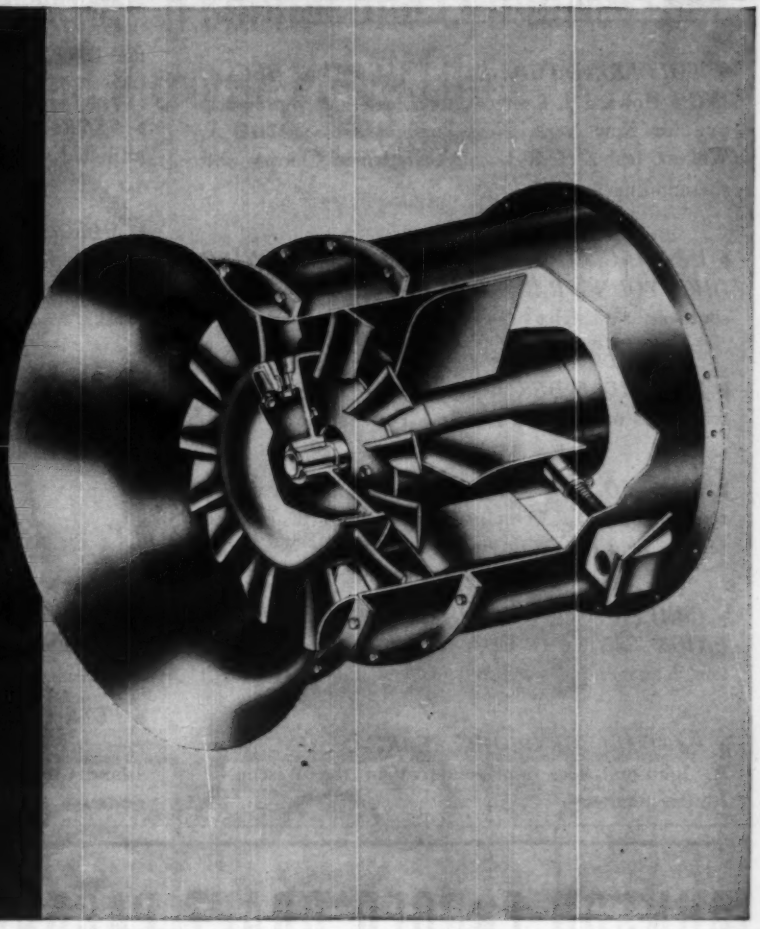
▸ *WAGNER ELECTRIC CORP.* — L. E. Long, manager of San Francisco electrical sales branch.

IT'S EASIER TO INSTALL A JOY FAN

JOY AXIVANE FAN



OLD STYLE FANS



JOY FANS SAVE SPACE

simplify engineering and installation

When you install a Joy fan you install a simpler system of ventilation. The Joy fan offers high performance in a compact package. The fan fits right into the duct . . . and the motor is inside the fan.

Saves cost because the installation can be made during the fabrication of the duct system. **Saves cost** because the installation can be made by relatively unskilled labor. **Saves cost** because the duct system is simpler . . . no offsets or elbows.

Saves cost because it turns valuable space over for rental or use (value averaging $5.00 per sq. ft. per month).

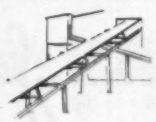
Study the drawings above. Notice the efficiency and compactness of the Joy fan compared to other systems . . . then call in a Joy engineer. ***Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa.*** In Canada: *Joy Manufacturing Company (Canada) Limited, Galt, Ontario.*

WSW I 6828-199

WRITE FOR FREE BULLETIN 199-41

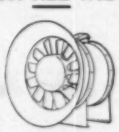
JOY... EQUIPMENT FOR INDUSTRIAL PLANTS... FOR ALL INDUSTRY

Industrial Compressors



Conveyors

Electrical Connectors



Fans and Blowers

WHO'S WHAT

Continued

▸ *WOLVERINE TUBE DIV., CALUMET & HECLA, INC.*—Howard J. Luetzow, technical sales representative for New York, New England areas; Mark A. Wallesz, technical sales representative in Chicago and surrounding areas.

▸ *HEATING, COOLING AND AIR CONDITIONING DIV., YOUNG RADIATOR CO.*—Russell G. Beck, southeastern district sales supervisor.

▸ *HOWARD INDUSTRIES*—Bernard B. Sachs, district sales manager of the New York territory.

▸ *KENT CO., INC.*—Clyde Kelly, Sr., manufacturer's representative in Memphis, Tenn.; John R. Fischer, regular field sales representative in Middle West.

▸ *GRAVER WATER CONDITIONING CO., DIV. OF UNION TANK CAR CO.*—Howard G. Egginson, district manager in New England.

▸ *RANDALL GRAPHITE BEARINGS, INC.*—Roy A. Johnson, sales representative in the Wisconsin-Illinois territory.

▸ *RESEARCH PRODUCTS CORP.*—John Kauffman, district salesman in Virginia, Maryland and Washington, D. C., territory.

▸ *GEORGE W. AKERS CO.*—Norman H. Van Horn, affiliated as sales engineer.

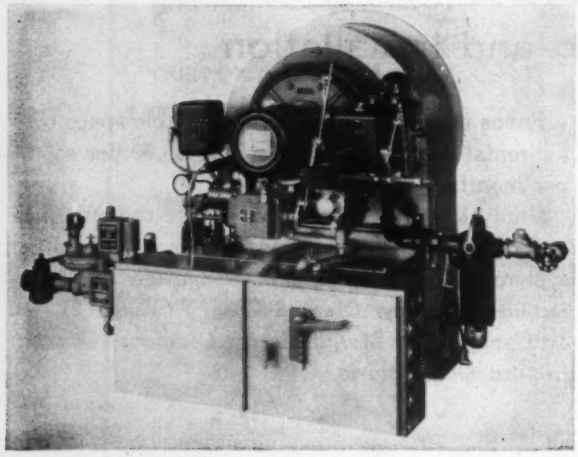
▸ *MITCHELL MFG. CO.*—Jim Gaynor, Gaynor Sales Agency, St. Paul, Minn., district sales manager for Minnesota, North Dakota, South Dakota, Iowa, Nebraska, Kansas, Missouri, northern Wisconsin.

▸ *FEDDERS-QUIGAN CORP.*—Frank Luksha, southeast district manager for North and South Carolina, Georgia, Alabama, Florida, most of Tennessee.

▸ *WESTINGHOUSE ELECTRIC CORP.*—George Steiner, regional manager of midwestern region for company's Sturtevant division; American Air Conditioning and Heating Corp., distributor of company's products in Bridgeport, Conn., area.

▸ *PETROMETER CORP.*—Charles Muller, sales engineer for company's complete line at plant in Long Island City. He will serve as factory technical representative on instrument installation and operation.

JOHNSON FORCED DRAFT PACKAGE-UNIT BURNERS



Completely Factory Assembled & Mounted

For firing with Oil only . . . Gas only . . . or combination Oil and Gas. Completely assembled and rigidly mounted at the factory ready for easy, inexpensive attachment to any boiler or heat receiver. They provide smoother, more efficient combustion regardless of stack conditions and firebox pressure variations.

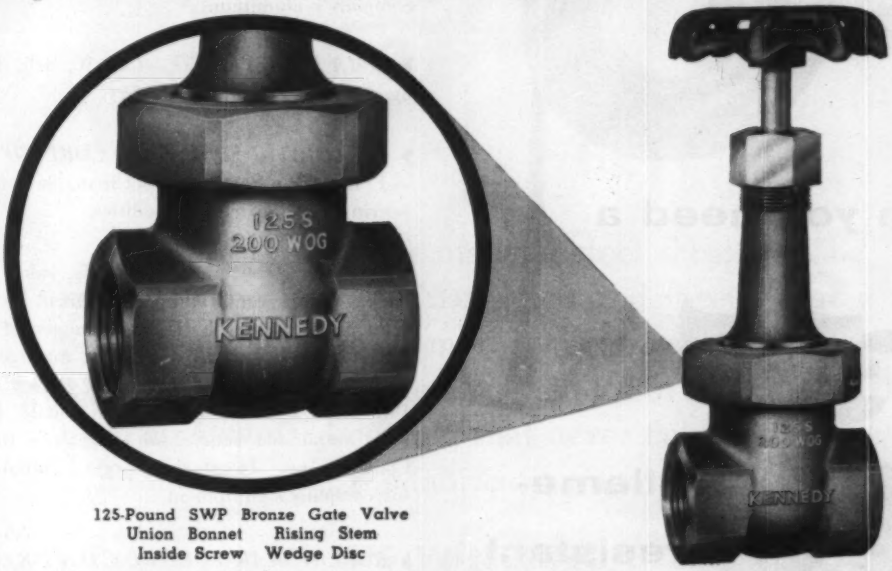
Powered by the world famous Johnson Model 53 Burners, these "packaged" units are available for any heating need, in sizes from 25HP to 500HP. If you want the last word in heating efficiency and economy, investigate these new Johnson Forced Draft Package Unit Burners.

Johnson Oil Burners

Builders of fine Oil Burner Equipment since 1903

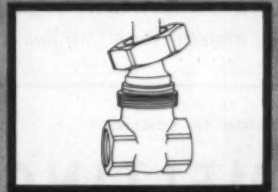
S. T. JOHNSON CO.
940 Arlington Ave., Oakland 8, Calif.
Church Road, Bridgeport, Pennsylvania

Here's How KENNEDY'S Union Bonnet and Cylindrical Body Simplify Installation and Increase Valve Life...

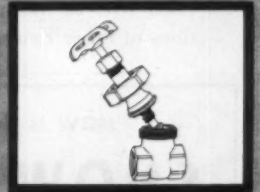


125-Pound SWP Bronze Gate Valve
Union Bonnet Rising Stem
Inside Screw Wedge Disc

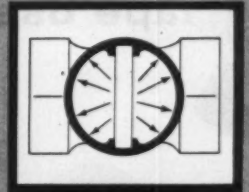
Fig. 525



Kennedy's Union Bonnet permits repeated dismantling for cleaning or inspection and reassembly without danger of distortion of the valve. The bronze-to-bronze construction makes a tight union for tight, leakproof operation.



Kennedy's Fig. 525 can be easily disassembled into component parts for installation in otherwise inaccessable places in existing lines or for new installations.



Kennedy's cylindrical body construction when under severe pressure resists rupture and minimizes deflection thus preventing leakage at the seat.

Pressure in ordinary non-cylindrical valve bodies tries to push the body wall out to form a circle or cylinder. Rupturing stresses concentrate where wall has the shortest radius. Resultant deflection causes leakage over disc and early failure.

These additional advantages make KENNEDY your best valve buy...

Rugged, wider hex ends, blended into body, prevent distortion. On a conventional valve body, hex ends protrude from the body and are connected by thin body wrists. This area under severe wrench pressure, can distort and cause disc seating trouble. Kennedy's wider hex ends are blended into the body making the body and hexes one unit. In this way wrench pressure can be absorbed.

Newest in the valve field . . . best in the valve field . . . Fig. 525 gives greater strength with less bulk and weight than any comparably rated valve.

Kennedy's Fig. 525 can be repacked under pressure, eliminating line shut-downs. You simply open valve fully, remove packing nut and then repack.

• *YOU CAN'T BUY A BETTER VALVE THAN A KENNEDY!*

KENNEDY VALVE MFG. CO.

1607 East Water St. ELMIRA, NEW YORK

VALVES • PIPE FITTINGS • FIRE HYDRANTS

• OFFICES AND WAREHOUSES IN NEW YORK, CHICAGO, SEATTLE, SAN FRANCISCO, ATLANTA • SALES REPRESENTATIVES IN PRINCIPAL CITIES •

When you need a

flame-resistant tape use

F-R ARNO DUCTAPE

Flame-Resistant Arno Ductape complies with all building codes that require the use of fire-resistant duct tape. It continues to hold firmly at temperatures of 350-400 deg. F. Even at higher temperatures, while subject to charring, it will not support flame. Of course, it meets ASTM standards.

Like all other Arno Tapes, it sticks instantly and does not dry out or lose its grip.

Seal all ducts with Arno Ductape. Use Flame-Resistant Ductape where extra fire protection is needed.

Test sample on request — specify F-R.

Sales Offices

Atlanta—2258 B Cascade Rd. S.W.
Detroit—12915 W. Eight Mile Road
Fort Worth—2724 Tillar Street
Los Angeles—3225 East 46th Street
Minneapolis—401 Plymouth Ave. North
New York—104 West 17th Street

Arno
ADHESIVE TAPES, INC.
Subsidiary of The Scholl Mfg. Co., Inc

Arno Adhesive Tapes, Inc., 4140 Ohio Street, Michigan City, Indiana

WHO'S WHAT — *Continued*

▸ *OLIN MATHIESON CHEMICAL CORP.*—Edward B. Reynolds, New York regional sales manager for company's aluminum.

▸ *LIMA REGISTER CO.*—Carl W. Bell, district manager of North Central territory.

▸ *AUTOMATIC SPRINKLER CORP. OF AMERICA*—J. J. Durkin Seattle district manager for sales, engineering and fabricating facilities.

▸ *TRANE CO.*—Spiro J. Beletsis, sales engineer of packaged air conditioning equipment in New York sales office; James F. Hield, manager of Peoria, Ill. sales office; Robert P. Blackburn, manager of Davenport, Iowa sales office; Robert W. Tobey, manager of Pittsburgh sales office; F. H. McDonald, Inc., Miami, Fla., authorized source for company's line; Climate Control, Inc., Decatur, Georgia, authorized source for company's equipment.

▸ *ROBERTSHAW-FULTON CONTROLS CO.*—George H. Giesler, sales representative of Fulton Sylphon Div. in Nashville, Knoxville, Chattanooga, portions of lower Kentucky, western North Carolina. ‡

NOW is the time to consider

SNOW MELTING

Systems around Buildings and Grounds

Better send at once for our SNOW MELTING MANUAL. Here are design data based on a study of—and others' actual experience with over 100 snow melting systems of all kinds for

- **LOADING PLATFORMS and DOCKS**
- **SIDEWALKS • ROADS • DRIVEWAYS**
- **MARQUEES • PARKING AREAS**
- **RUNWAYS • RAILWAY SWITCHES**

and other applications which HAVE proved that this modern method of snow removal.

Costs No More Than Other Methods

—and because snow melting by pipe coils has other distinct advantages, such as dirt-free sidewalks and entrances, and the complete elimination of ice surfaces, the demand for this method of snow removal is swiftly growing.

Complete information on the correct design, installation and operation of snow melting systems is offered in the new SNOW MELTING MANUAL, a reprint of articles originally published in HEATING, PIPING & AIR CONDITIONING. Fifty cents per copy.

$0.50 will bring you this SNOW MELTING MANUAL . . . a valuable addition to your file on business opportunities.

Heating, Piping & Air Conditioning

6 North Michigan Avenue **Chicago 2, Illinois**

Anything that can be made of steel sheets can be made of Wheeling SofTite Galvanized Sheets–that's been our challenge from the beginning. It stands today! For easily worked Wheeling SofTite Sheets have a galvanized coating that never flakes or peels ...no matter what the fabricating operation.

IT'S WHEELING STEEL

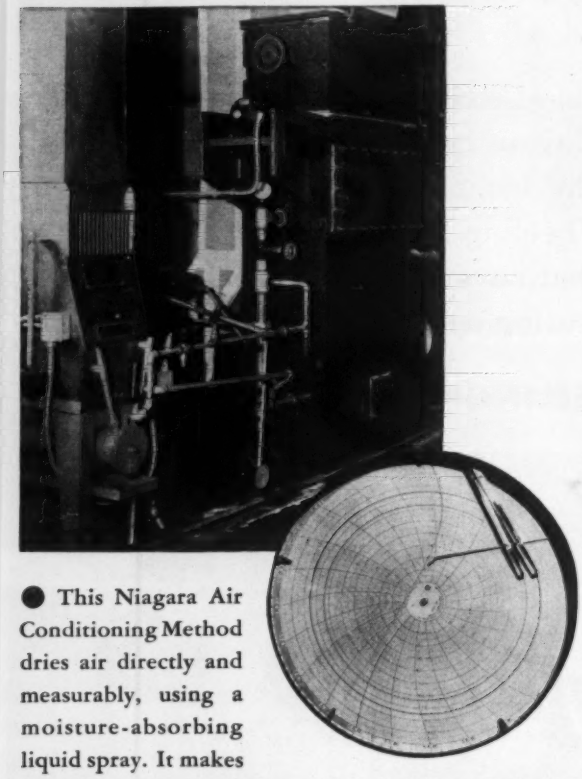
WHEELING STEEL

WHEELING STEEL CORPORATION, WHEELING, WEST VIRGINIA *District Sales Offices at Atlanta, Boston, Buffalo, Chicago, Cincinnati, Cleveland, Detroit, Houston, New York, Philadelphia, St. Louis, San Francisco, Wheeling*

EXACT CONTROL

of Moisture Content

To Improve Your Product or Protect Your Materials or for Processes or Tests



● This Niagara Air Conditioning Method dries air directly and measurably, using a moisture-absorbing liquid spray. It makes humidity control a separate function from lowering or raising temperatures and gives you precise control with thermostats alone; no moisture-sensitive devices are needed. You have simpler, more trustworthy, less expensive control instrumentation. Niagara precise-control installations have the best record for reliability.

Niagara Air Conditioning provides you with any temperature and relative humidity you need. Using "Hygrol" absorbent, it is not expensive to operate, saving the refrigeration commonly used to condense moisture and making re-heat unnecessary in most cases. It gives large capacity with compact, easily-maintained equipment. Ask for Descriptive Bulletins #112 and #121. Address Dept. HP-4

NIAGARA BLOWER COMPANY

405 Lexington Ave. New York 17, N. Y.

District Engineers in Principal Cities of U. S. and Canada

WE HEAR THAT . . .

▸ *WATER SERVICE LABORATORIES, INC.* has moved its Philadelphia offices and laboratory to 169 W. Wyoming Ave. Almost four times more space is available at the new branch. Larger quarters for a service annex have also been leased for the company's New York headquarters, and a branch office has been opened in Richmond, Va.

▸ *BOUND BROOK OIL-LESS BEARING CO.*, marking its 75th anniversary in the industry, will build a modern powder metallurgy fabricating plant at Sturgis, Mich. At the same time, the company is also modernizing and expanding its home plant and large research facilities in New Jersey. Production schedules there will remain unchanged.

▸ *ROCKWELL MFG. CO.'s* new 106,000 sq ft manufacturing plant and West Coast repair center at Porterville, Calif., is now in limited production.

▸ Another group of graduates from U. S. and Canadian colleges and universities have just completed *TRANE CO.'s* specialized engineering program and received their sales assignments in the field. Seventeen states and three Canadian provinces were represented in the group.

▸ Two scholarship awards have been established by the Portland, Ore., divisions of *IRON FIREMAN MFG. CO.* for entering freshman at Oregon State College and Portland State College. The scholarships were established to emphasize the country's need for more college graduates and to develop interest in engineering as a profession.

▸ *SMITH-BLAIR, INC.* has opened a new 6000 sq ft assembly plant, warehouse, and regional sales office at Henderson, Texas.

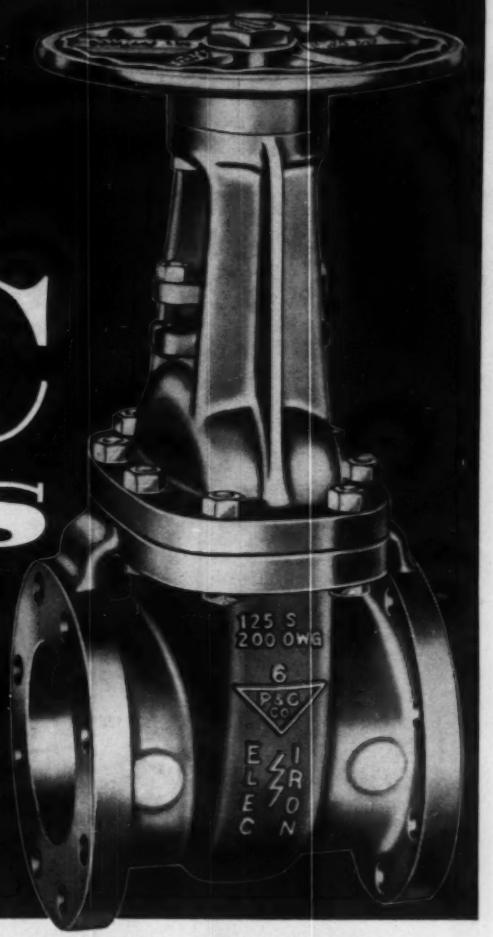
▸ A new building with 61,000 sq ft of floor space was recently opened by *WALWORTH CO.* in Glenshaw, Pa. The new building will house the company's Central Div. sales and distribution facilities for the greater Pittsburgh area.

▸ To provide working space for its rapidly expanding research operations, *RANCO INC.* is now constructing a new research center near Fort Lauderdale, Fla. The new building was necessary because of the increase in research and development activities and because the company plans to increase its Fort Lauderdale staff.

ACCO
for Better
Values

R-P&C VALVES

THE COMPLETE LINE
—DESIGNED FOR DEPENDABILITY



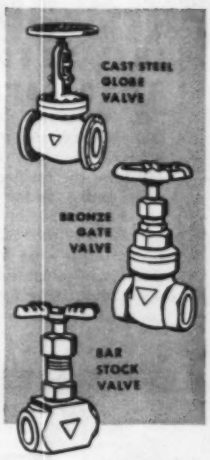
Created by R-P&C—made and sold exclusively by R-P&C...Electric Furnace Iron Valves

Electric furnace iron—introduced exclusively in R-P&C Valves—provides a high quality cast iron that meets the exacting requirements for pressure castings. Melted and refined under closest metallurgical supervision, R-P&C Electric Iron has physical properties *far exceeding the minimum standards* to which they must conform. It has a balanced chemical composition and a tough, dense body structure; and, it is more resistant to corrosion. All cast iron parts of R-P&C Valves are made of this Electric Furnace Iron.

Shown above is **Fig. 625**, a general service valve which is particularly applicable where full, unobstructed flow is desired. This type, available in bronze-trimmed or all-iron style, either flanged or screwed, is made in fifteen sizes, from 2″ to 24″—and is typical of the better values offered by the entire line of R-P&C Electric Iron Valves.

The R-P&C Line is Complete

The R-P&C line embraces gate, globe, angle and check valves in bronze, electric furnace iron and cast steel, and forged steel; all in a wide range of sizes, styles and pressure classes. Also, R-P&C offers specialties such as Lubrotite gate valves, bar stock valves, asbestos-packed cocks, cast steel fittings and pressure-seal cast steel valves. Order through your nearby R-P&C Distributor. For complete catalog, write our Reading office.



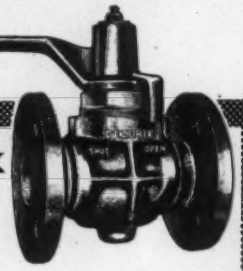
FREE WALL CHART
"How to Protect Your Valves"
Installation pointers, operating tips, clues to longer valve life. They are all on this 22″ x 17″ wall chart. Write for your free copy.

R-P&C VALVE DIVISION
AMERICAN CHAIN & CABLE

Reading, Pa., Atlanta, Boston, Chicago, Denver, Detroit, Houston, New York, Philadelphia, Pittsburgh, San Francisco, Bridgeport, Conn.

ACCO

When you want results.. specify

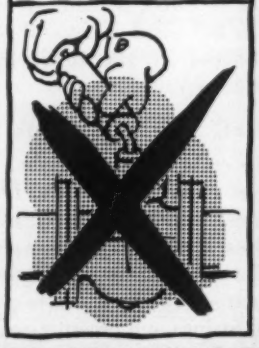


DeZurik Plug Valves

THEY DON'T LEAK
The resilient-faced plugs of DeZurik Valves guarantee dead-tight shut-off on any line despite dirt, grit or scale in the line. The cushioned closure seals around particles in the flow. Performance is the same, whether valving thick slurries, clear liquids or gases.

THEY OPEN EASILY
Eccentric Action, found only on DeZurik Valves, provides the easiest operation ever! The plug touches the seat only when the valve is closed. Opening the valve backs the plug away from the seat—no friction to overcome, no drag, no binding! One easy quarter-turn from wide open to dead shut!

THEY NEED NO LUBRICATION
DeZurik Valves need no lubrication! Their tight shut-off and easy operation result from the resilient-faced plug and eccentric design. No lubrication means no greases or guns to stock, no constant lube maintenance, and—most important—no product contamination on critical applications!



Representatives in all principal cities.
Or write to

DeZURIK CORPORATION
SARTELL, MINNESOTA

WE HEAR THAT

Continued

▸ *AIR MOVING AND CONDITIONING ASSOCIATION* has elected *JENN-AIR PRODUCTS CO.*, and *E. VAN NOORDEN CO.* to membership in the association.

▸ *TRANE CO.* achieved the finest safety record in its history during 1957. The company finished the year with an accumulated accident frequency rate of 3.92—a new all time low.

▸ *DIAMOND CALK HORSESHOE CO.* has been renamed *DIAMOND TOOL AND HORSESHOE CO.*

▸ A new building with facilities for research and development of old and new products has been opened by *NICOLET INDUSTRIES, INC.* in Florham Park, N. J. The 20,000 sq ft of expandable space includes office areas, chemical laboratory, physical testing laboratory, engineering section, workshop and pilot area.

▸ *LIBBY-OWENS-FORD GLASS CO.* will expand facilities at their technical center in Toledo, with emphasis on engineering, research and development, in 1958 .

▸ *LAU BLOWER CO.* is engaged in research on hemispherical and oval shaped plastic structures now made by several manufacturers. These portable structures are in use as warehouses and swimming pool covers. The research program has been initiated to learn what it takes to keep such a structure up and what is required for air conditioning and heating.

▸ The engineering firm of *JOHN PAUL JONES, CARY & MILLAR* is now officially known as *BYERS, URBAN, KLUG & PITTENGER*. The name change recognizes the team of engineers which now represents the firm.

▸ *CLEVELAND CONTROLS, INC.* is the new name of the *CLEVELAND FUEL EQUIPMENT CO.* The new name was selected as being more descriptive of the company's new products and plans.

▸ *JOHN H. EHN*, president, *VULCAN RADIATOR CO.*, was honored last month at a testimonial dinner given in his honor in recognition of his 30 years of leadership and direction of the Vulcan Radiator Co. About 500 guests attended and tribute was paid to Mr. Ehn for his courage and vision as a pioneer of finned tube and baseboard radiation in America.

chosen to heat the building and entrances of the

WORLD'S LARGEST OUTDOOR SKATING RINK

The twenty-two industry-approved, performance-proved features of Airtherm Cabinet Unit Heaters made them first choice for this world famous project. These, combined with an Airtherm Centrifugal Fan Heating and Ventilating Unit and Propeller Fan Unit Heaters, will guarantee efficient, trouble-free heating performance through the years.

Note: The Centrifugal Unit heats the major portion of the building through perforations in the acoustical aluminum ceiling, automatically providing 100% outside air during the day and re-circulated air at night.

SEND FOR CABINET UNIT HEATER CATALOGUE #1402

Contains specifications on 8 models from 304 CFM to 1600 CFM, and 22,200 BTU to 124,800 BTU.

The Mark Steinberg Memorial Skating Rink Operated by the City of St. Louis provides 230' x 120' of ice—the largest artificial outdoor ice skating rink in the world. Adjoining building houses a kitchen, snack-bar, skate rental and change area, pro shop, storage, first-aid and office.

Architect: Frederick Dunn & Associated Architects
General Contractor: Robert Paulus Construction Co.
Consulting Engineers: Ferris & Hamig
Mechanical Contractor: Shure-Richardson, Inc.

Convectors • Propeller Fan Unit Heaters • Direct Fired Space Heaters • Gas Fired Unit Heaters • Centrifugal Fan Unit Heaters
Cabinet Unit Heaters • Air Conditioning Units

AIRTHERM MANUFACTURING COMPANY, 702 S. SPRING, ST. LOUIS 10, MO.

WE HEAR THAT

Continued

▸ *UNITED WIRE & SUPPLY CORP.* will stock its complete line of copper water tube, refrigeration tube, oil burner tube and packaged aluminum tube at their new warehouse, 651 Humphries St., Atlanta, Ga.

▸ At the conclusion of the annual sales meeting of the *Y. A. McDONALD MFG. CO.* two special awards were given. *O. V. GIBBONS* was named outstanding district manager of the year, and *A. G. DYSON* was honored as outstanding salesman of the year.

▸ The partership of *REBMANN & GAY* has been expanded to *REBMANN GAY HEROLD, CONSULTING ENGINEERS*, with the addition of *GEORGE F. HEROLD* as partner. The location of the organization will remain the same, but the staff has also been expanded.

▸ *R. L. GRAY*, president of *ARMCO STEEL CORP.*, and *A. W. McKINNEY*, president of the *NATIONAL SUPPLY CO.*, announced that a joint plan and agreement of merger between the two companies has been executed, planned effective April 30. The proposed merger will be submitted to stockholders at meetings to be held April 16 and 17.

▸ *THERM-O-DISC, INC.* are now occupying their new plant outside of Mansfield, Ohio. The new plant more than doubles their previous working area, utilizing 85,500 sq ft of floor space to house their development and testing laboratories, engineering department, production, manufacturing and sales.

▸ *TRANE CO.* has earned an "excellent management" rating in the seventh annual U. S. and Canadian company analysis conducted by the American Institute of Management.

▸ *WEBSTER ELECTRIC CO.* research and design engineers and draftsmen have just moved into a new wing recently completed at the company's Racine plant. A complete wing of the plant has been renovated for this department.

▸ Introduction of new products and a review of the company's progress during the past several months was the topic of a recent meeting between the management of *EMBASSY STEEL PRODUCTS* and its eastern sales representatives.

▸ *WALWORTH CO.* has moved into new and larger quarters at 750 Third Ave., New York 17. The company's executive offices will occupy a whole floor in the recently completed building.

THE **weil** TVC

New 26 Gallon TVC Receiver

Condensate Pumps

- LOW RETURN CONNECTION
- LOW SPEED — LONG LIFE
- CAST IRON RECEIVER
- LOW WATER LINE

Capacities to 15,000 sq. ft. E.D.R.

Features:
Low speed (1750 RPM) TVC pumps are easily installed in areas where space is important. Their compact cast iron receiver and sturdy pumping unit assure a trouble-free installation.

Dimensions:
26 gallon cast iron receiver for single or duplex units: Diameter 25"; height of return above floor 10½"; height of unit 36" max.

Installation:
Simple installation: one return connection, one discharge connection. Unit is completely assembled at the factory. Send for Bulletin TVC-300.

Send for Bulletin TVC-300

See Catalog in 1958 Sweet's and 1958 Domestic Eng. Cat. Dir.

Available from Jobbers Stocks!

TVC PUMPS now available in capacities from 750 to 15,000 sq. ft. E.D.R.

The three sizes of TVC receivers now offer a complete line of low pressure system condensate pumps to fit all requirements. The LOW RETURN CONNECTION and LOW SPEED — 1750 R.P.M., coupled with the built-in durability, operating efficiency and low cost of these pumps guarantee a satisfactory and trouble free installation. This pump provides gravity drainage for low heating units.

Specify and install a **weil** TVC Pump.

Built for ONE MILLION STARTS . . . without attention

weil PUMP CO.

1514 North Fremont Street • Chicago 22, Illinois

UNIQUE DAMPER IN CONNOR KNO-DRAFT

HIGH VELOCITY VALVE ATTENUATOR

Assures COMPLETE CLOSE-OFF

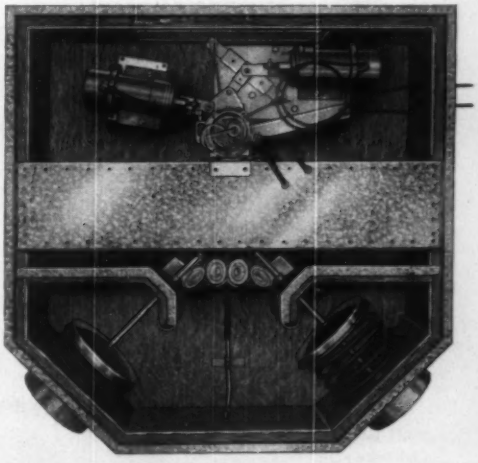
NEW series "45"

PATENTED HELICAL NEOPRENE SPRING DAMPER throttles high velocity air by governing flow of air from supply duct into mixing chamber. Air passes from duct into mixing chamber (arrows) through spaces between spring's coils. Control mechanism compresses spring, throttling or completely closing off air flow. Aging-resistant neoprene tubing forms soft-walled venturi section when throttling . . . air-tight seal when closed.

The CONNOR KNO-DRAFT "series 45" Valve Attenuator offers important new advantages for dual duct installation.

The exclusive patented HELICAL NEOPRENE COATED SPRING DAMPER positively assures complete close-off . . . full cooling and heating realized because damper shuts with less than 2% leakage. Damper action is linear, and operation is extremely quiet because high velocity air is throttled through soft-walled venturis and discharged radially.

This unique damper and the precisely engineered combination of other important features makes these High Velocity Valve Attenuators matchless for constant, quiet, controlled performance.



- **UNITIZED LINKAGE MECHANISM**—reduces friction, eliminates control lag, insures precise temperature regulation, permits easy servicing.
- **CONSTANT VOLUME CONTROL**—Manual volume control also available.
- **CHOICE OF SOUND BAFFLES**—Sinuous or Flat Plate.

CONNOR... for Constant Comfort Conditions

Write for complete information.

CONNOR kno·draft®
high velocity air diffusers

CONNOR ENGINEERING CORPORATION
81 SHELTER ROCK ROAD • DANBURY • CONNECTICUT

NO BLASTS
NO COLD CORNERS
NO HOT SPOTS
. . . just pure comfort!
WITH STANDARD'S NO. 551 PERIMETER WALL REGISTERS
Air is diffused 4-ways, along the outer cold walls, providing complete 360° hemispheric heating or cooling.
New fractionator volume control,
Standard screw holes,
Single shutter control, smart appearance, for sidewall or baseboard installation.
See for yourself why Standard's 551 is the best perimeter wall register on the market!
MAIL THE COUPON FOR FREE LITERATURE.

STANDARD STAMPING & PERFORATING COMPANY
3125 WEST 49TH PLACE, CHICAGO 32, ILLINOIS
Gentlemen: Please send me literature on the Standard No. 551 Perimeter Wall Register.

NAME_____
COMPANY_____
ADDRESS_____
CITY_____ ZONE____ STATE_____

Standard

WE HEAR THAT

Continued

▸ *TRANE CO.* has established its eighth regional warehouse distributing center in Miami, Florida. The purpose of the distributing warehouse is to provide immediate deliveries of self-contained air conditioners.

▸ *WIGTON-ABBOTT CORP.* has started work on a modern research center for the *HOOKER ELECTROCHEMICAL CO.* near Niagara Falls, N. Y. The center will occupy a 61 acre site on Grand Island and initially contain about 69,000 sq ft of air conditioned laboratory, office, utility and storage space.

▸ *COBELL INDUSTRIES INC.* has moved both executive offices and production facilities to their new plant in Cleburne, Texas. The recently completed 40,000 sq ft plant is equipped to meet expanded production requirements. In conjunction with the move, the company will market all units under the single brand name "Rangaire".

▸ *CHARLES H. HODGES, JR.*, president of the *DETROIT CONTROLS DIV.* has been appointed to direct a special growth and development study in the controls and instrumentation field for *AMERICAN RADIATOR & STANDARD SANITARY CORP.* He will relinquish his duties as president to formulate objectives for the division.

▸ *BARRY BLOWER CO.* has added 60 percent to its factory work space. It has also completed construction of a new test laboratory area and office.

▸ For the second consecutive year *TRANE CO.* is offering eight two-year pre-engineering scholarships to high school senior boys in the La Crosse, Wisconsin area. The purpose of the program is to encourage young men to elect engineering technician careers, with subsequent employment at the company.

▸ Officials of *CLYDE TUBE FORGINGS OF AMERICA, INC.* have announced that the name of their firm has been changed to *TUBE FORGINGS OF AMERICA, INC.*

▸ *SLANT-FIN RADIATOR CORP.* has opened a Cleveland office at 3939 Wendy Dr. to serve the central and northern portions of Ohio. Clifford Rutter is the manager.

▸ The name *WEKSLER THERMOMETER CORP.* has been changed to *WEKSLER INSTRUMENTS CORP.*

WE HEAR THAT

Continued

▸ *DeZURIK SALES CO.* has moved its office from Maplewood, N. J., to 24 Franklin Pl., Summit, N. J. The firm is the sales and service organization for *DeZURIK CORP.*, manufacturers of valves.

▸ *BARNEBEY-CHENEY CO.* has announced it has received an order to furnish activated coconut shell charcoal to *MINNEAPOLIS-HONEYWELL REGULATOR CO.* for use in air purification filters.

▸ Offices of *A. W. CASH CO.* are now located in downtown Decatur, Ill. Former offices at the company's plant at 18th and El Dorado Sts. in the city have been converted to additional manufacturing space.

▸ *WATER SERVICE LABORATORIES, INC.* has moved its New York office and laboratory to 615 W. 131st St. The new headquarters contains 50 percent more space than the service organization's former location.

▸ *FLEXIBLE TUBING CORP.* has opened a new 16,300 sq ft manufacturing plant at 305 Crescent Way, Anaheim, Calif. The new plant will also house a sales office, warehousing facilities and a research and development laboratory.

▸ Warehousing and distribution of *CHASE BRASS & COPPER* products on the West Coast will be carried on by the company's new 62,000 sq ft warehouse and sales office. The new facility is located at 230 Shaw Rd. in South San Francisco.

▸ *TORRINGTON MFG. CO.* has built a 50,000 sq ft plant in Van Nuys, California, exclusively for the manufacture of fans and blowers. ⧺

Obituary

Harrison W. Marshall

HARRISON W. MARSHALL, 59, vice president and director of Buensod-Stacey, Inc., and one of the founders, died unexpectedly of a heart attack on February 14. A specialist in the air conditioning of multistory buildings ever since the founding of the company more than 20 years ago, Mr. Marshall was active in the contracting services of the company. Mr. Marshall was formerly an executive of the Carrier Corp., and was at one time chief engineer of its Tokyo branch. ⧺

It's the . . . Sterlco®

THERMOTROL

for ACCURATE, INDEPENDENT ROOM TEMPERATURE CONTROL

STEAM or HOT WATER SYSTEMS

. . . for modernization or new construction

CAN BE KEY LOCKED

for ... HOSPITALS, APARTMENTS, OFFICES, HOTELS, SCHOOLS, MOTELS, INSTITUTIONS and PUBLIC BUILDINGS

- **COMPLETELY SELF-CONTAINED**
  Each Sterlco Thermotrol is a complete temperature control unit, easily installed in any two-pipe system in place of the manual valve. NO wiring or other external connections needed.
- **MODULATING CONTROL—NOT on AND off**
  Each Sterlco Thermotrol provides steady, even control to each radiator the way YOU want it. Radiators in cold spots give off heat while those in warmer parts of the same room are automatically throttled down.
- **NO ELECTRICAL CONNECTIONS**
  No electric wiring, additional piping, or other connections are required with the Sterlco Thermotrol. Just as easily installed for modernization as for new construction.

FOR BUILDING MODERNIZATION

With a Sterlco Thermotrol on each radiator, stuffy overheated rooms, open windows, and excessive fuel bills are eliminated. You pay for only the heat you need . . . rooms are comfortably, evenly warm . . . occupants comfortable.

FOR NEW CONSTRUCTION

Here's modern ZONE CONTROL for radiant systems. The only modern solution to inefficient "on-off" valves and expensive, motorized valves.

STEAM HEATING IS MODERN, EFFICIENT and DEPENDABLE

Sterlco Products Distributed through

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STERLING, INC.

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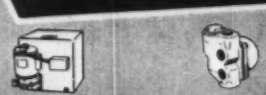


CONDENSATION AND VACUUM PUMPS | HEATING SPECIALTIES | TEMPERATURE CONTROLS

MEETINGS & CONVENTIONS

1958

APRIL 21-26—*National Industrial Health Conference.* Haddon Hall, Atlantic City, N. J. Joint meeting of American Industrial Hygiene Association, American Conference of Governmental Industrial Hygienists, Industrial Medical Association, American of Industrial Dentists, American Association of Industrial Nurses. Advance registration—Room 1300, 28 E. Jackson Blvd., Chicago 4.

APRIL 23-24—*Bituminous Coal Research, Inc.*, annual meeting and sales conference. Penn-Sheraton Hotel, Pittsburgh, Pa. BCR headquarters: 121 Meyran Ave. at Forbes, Pittsburgh 13.

MAY 4-7—*Air-Conditioning and Refrigeration Institute*, annual meeting. The Homestead, Hot Springs, Va. ARI headquarters: 1346 Connecticut Ave., N. W., Washington 6, D. C.

MAY 7-11—*Western Air Conditioning, Heating, Ventilating and Refrigeration Exhibit and Conference.* Shrine Exposition Hall, Los Angeles. Sponsored by Western Air Conditioning Industries Association. Information: Fred J. Tabery, exhibit manager, 3443 S. Hill St., Los Angeles 7.

MAY 8-10—*Sheet Metal and Air Conditioning Contractors' National Association, Inc.*, annual convention. Eden Roc Hotel, Miami Beach. Information: Joseph D. Wilder, executive secretary, 170 Division St., Elgin, Ill.

MAY 11-14—*Fluid Controls Institute, Inc.* Lake Placid Club, Lake Placid, N. Y. Information: Fluid Controls Institute, Inc., P. O. Box 191, Decatur, Ill.

MAY 19-23—*National Fire Protection Association*, 62nd annual meeting. Palmer House, Chicago. The association is at 60 Batterymarch St., Boston.

MAY 20-23—*Mechanical Contractors Association of America, Inc.*, 69th annual convention. Ambassador Hotel, Los Angeles. Information: MCAA headquarters, 45 Rockefeller Plaza, New York 20.

JUNE 2-5—*National District Heating Association*, 49th annual meeting. French Lick-Sheraton Hotel, French Lick, Ind. Information: John F. Collins, Jr., secretary-treasurer, 827 N. Euclid Ave., Pittsburgh 6.

JUNE 9-13—*Fourth International Automation Ex-*

FASTEN METALS FASTER

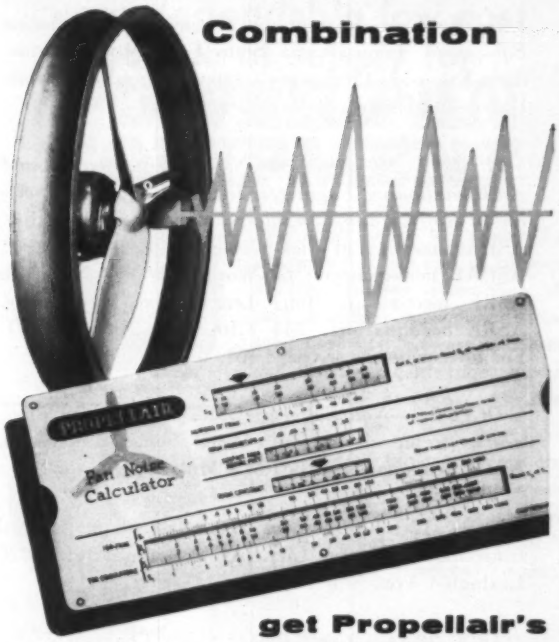
WIDE RANGE OF TONGS SUIT MILLER PORTABLES FOR EVERY SHEET METAL APPLICATION

Miller portables require no pampering, stand up to the job for years on end. Light weight, plus "probe" design, produces high volume of low-fatigue work. Natural position handle threads into either side of welder, lever locks tongs firmly to work. Model MSW in either 110v or 220v, weighs 23 lbs., welds 1/8" mild or stainless steel, or two 20 ga. galvanized sheets; model LMSW, 220v, weighs 31 lbs., welds to 3/16" of mild or stainless, or two 16 ga. galvanized pieces. Timers available for both models.

miller ELECTRIC MANUFACTURING COMPANY, INC.
Appleton, Wisconsin

Distributed in Canada by Canadian Liquid Air Co. Ltd., Montreal, P. Q.

New! Simple Slide Rule Accurately Specifies Quietest Fan Combination



get Propellair's new Fan-Noise Calculator

The Fan-Noise Calculator permits prediction of resultant noise that one or more fans will make in rooms of any particular dimensions, construction and accoustical treatment.

Propellair's sone rating system for fans is simple and easily understood. It's based on frequency spectrum noise analysis plotted against the actual effect on the human ear. The sone system is far superior to inaccurate and improperly used decibel ratings . . . permits realistic direct noise comparisons (ten sones are twice as loud as five sones, etc.).

Now you can specify the quietest fan combination your room requires. Order your Fan-Noise slide rule calculator today! Send $1.00, with your name and address, to Propellair Division, Dept. HP, Robbins & Myers, Inc., Springfield, Ohio.

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if it's a water cooled system...

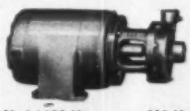
THERE'S A

MYERS centri-thrift pump

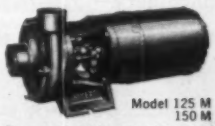
THAT'S RIGHT FOR THE JOB

for walk-in coolers • food freezers • frozen food lockers • chillers • air conditioning • cooling towers

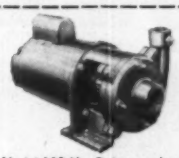
Ruggedly built for continuous duty, the general duty Myers Centri-Thrift features an all bronze impeller, removable wearing ring, and stainless steel shaft. The line offers a full range of sizes: from 1″ x 1¼″ through 2″ x 2½″ and from ⅓ to 7½ horsepower. Capacities to 240 GPM, heads to 140 feet.



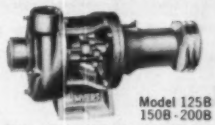
Model 150 M 200 M
Shown with rotary seal (available with stuffing box)



Model 125 M 150 M
Shown with stuffing box (available with rotary seal)



Model 100 M—Rotary seal only



Model 125B 150B-200B
Shown with stuffing box (available with rotary seal)

Model 100B Rotary Seal only

Write today for Catalog Section 210 covering the complete Myers Centri-Thrift line.

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THE F. E. MYERS & BRO. CO.
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Myers®

Easiest, *safest* way to anchor anything to concrete ceilings. Bulldogs drill in fast, *without* pressure on the hammer.

Bulldogs drill their own perfect fit. Wide expansion deep in the concrete provides the powerful Bulldog grip.

BULLDOGS

bite into concrete in seconds...

Anchor Anything Permanently!

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No load too great... no loosening from vibration. No drills to buy, no explosives required for fast, safe installation! Use Bulldog *self-drilling* Expansion Anchors in floor, wall, or ceiling concrete... for installing unit heaters, duct work, drain pipes, sprinkler systems, pipe supports, heater blowers, light fixtures, conduit, control boxes, machinery — *you name it!*

And one man does the job! Ask for free sample.

BULLDOG PIN BOLT DRIVES—
For anchoring in brick, concrete, tile, wood, or most any masonry block; ask for samples! . . . ideal for furring, window casements, conduits, awnings, convector installation.

SEE YOUR SUPPLIER

Bulldog self-drilling Expansion Anchors are made of fire-safe, case-hardened steel with sharply machined drilling teeth. Sizes ¾" to ⅞". Installed with electric or air hammer.

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Complete data on Bulldog self-drilling Expansion Anchors, Bulldog Pin Bolt Drives, Toggle Bolts and accessories.

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MEETINGS & CONVENTIONS *Continued*

1958

position and International Automation Congress. Coliseum, New York. Information: Richard Rimbach Assoc., 845 Ridge Ave., Pittsburgh 12.

JUNE 9-13—*Seminar on Electrical Precipitation Equipment.* Pennsylvania State University. Information: Extension Conference Center, Pennsylvania State University, University Park, Pa.

JUNE 23-25—*American Society of Heating and Air-Conditioning Engineers, Inc.* and *American Society of Refrigerating Engineers,* simultaneous meeting. ASHAE meeting at Pick-Nicollet Hotel, Minneapolis. ASHAE headquarters: 62 Worth St., New York 13. ASRE meeting at Hotel Leamington, Minneapolis. ASRE headquarters: 234 Fifth Ave., New York 1. For further details see page 161.

OCT. 5-8—*National Association of Corrosion Engineers,* technical session. Hotel Somerset, Boston. NACE headquarters: 1061 M & M Bldg., Houston 2.

OCT. 12-16—*American Gas Association,* annual convention. Atlantic City. AGA headquarters: 420 Lexington Ave., New York 17.

OCT. 20-24—*46th National Safety Congress & Exposition,* Chicago. National Safety Council, 425 N. Michigan Ave., Chicago 11.

OCT. 22-24—*Air-Conditioning and Refrigeration Wholesalers Association,* annual meeting. Sheraton-Palace Hotel, San Francisco. Information: 2607 N. High St., Columbus, Ohio.

NOV. 17-21—*Society of the Plastics Industry, Inc.,* eighth national plastics exposition. International Amphitheater, Chicago. To be held concurrently with the SPI annual national conference, Morrison Hotel, Chicago. SPI headquarters: 250 Park Ave., New York 17.

1959

JAN. 26-30—*14th International Heating and Air-Conditioning Exposition.* Philadelphia. Under auspices of the American Society of Heating and Air-Conditioning Engineers, in conjunction with its 65th annual meeting, also in Philadelphia. Exposition management: International Exposition Co., 480 Lexington Ave., New York 17. ASHAE headquarters: 62 Worth St., New York 13. ‡

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BLOWER COMPANY

your dependable low cost source of supply for

POWER FAN EQUIPMENT

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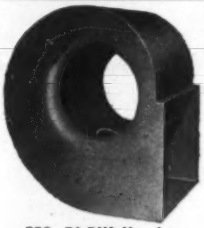
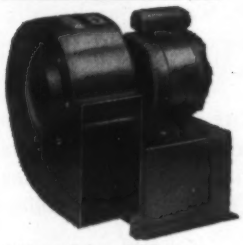


BFC, DI-DW Housing

BBI Blower Wheel SI-SW. Class 2.

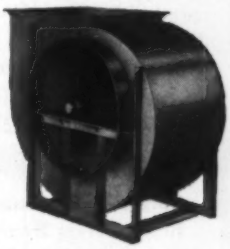


Direct Drive, All-Purpose Utility Blower

We offer users of power fan equipment a full line of blowers, multiple blower assemblies, direct and belt driven ventilating sets, cast iron blowers and various types of centrifugal blower wheels and housings. All sizes from 6" to 73".

ALL BARRY blower wheels and housings are precision made from steel, aluminum, brass, copper or stainless, and are expertly balanced and trued before shipment.

We make power fan equipment *exclusively*, and do not compete with our own customers . . . . . and, we have a high reputation for dependable quality and remarkably fast deliveries. Let us quote on our standard equipment, or upon your special sizes and specifications. Write us today.



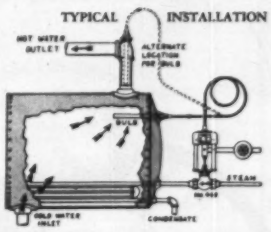
BBI Blower, SI-SW Arrangement No. 3, class 4

★ **A few territories are available for qualified sales representatives.**

BARRY BLOWER CO.

3100 California Street N.E. • Minneapolis 18, Minnesota

If you need to control **tank temperature**



call for a valve from

Klipfel

Klipfel Temperature Regulator Valves operate without auxiliary power. Pressure changes in a temperature-sensitive bulb are transmitted to a seamless, 2-ply, extra-strong bellows which opens or closes the valve smoothly to maintain desired temperature.

Wide Temperature Range **Indestructible Yoke**

Direct or reverse action **Manual override**

Single, double or three-way bodies

Call your supply house or write for Bulletin 354-A.

No. K-449 Temperature Regulator Valve

No. K-348 Temperature Regulator Valve

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Most items shipped within 24 hours after order is received

No. 410 Reducing Valve

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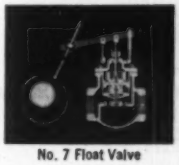

No. 7 Float Valve

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No. 135 Multiport Relief Valve

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Automatic Temperature-and-Pressure-Regulating Valves Since 1902

Float Valves • Temperature Regulators • Back Pressure Valves • Reducing Valves

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VELOMETER

A simple, direct reading on the Alnor Velometer gives you instant measurement of actual air delivery in any distribution system. This fast, precise method eliminates the time and money wasted in trial-and-error balancing...the profit-eating call-backs so often necessary with other less precise measurements.

The Velometer is the only instantaneous, direct reading air velocity meter—accurate in all ranges, from high to low... compact, portable, easy to understand and use. Wide assortment of jets and fittings makes this precision instrument ideally suited for all air velocity measurement.

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Take the recommendation of every major manufacturer of air diffusers and leading contractors—get an Alnor Velometer. You'll save time and money on the next installation you balance.

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NEW BOOKS & REPORTS...

1957 SUPPLEMENTS TO BOOK OF ASTM STANDARDS: Part I. Ferrous Metals—520 pp., Part 2. Non-Ferrous Metals—380 pp., Part 3. Cement, Concrete, Ceramics, Thermal Insulation, Road Materials, Water proofing, Soils—360 pp., Part 4. Paint, Naval Stores, Wood, Cellulose, Wax Polishes, Sandwich and Building Constructions, Fire Tests—218 pp., Part 5. Fuels, Petroleum, Aromatic Hydrocarbons, Engine Antifreezes—340 pp. Part 6. Rubber, Plastics, Electrical Insulation—423 pp., Part 7. Textiles, Soap, Water, Paper, Adhesives, Shipping Containers—280 pp. American Society for Testing Materials, 1916 Race St., Philadelphia 3. $4.00 per part; $28.00 per set.

PROPERTIES OF COMBUSTION GASES, VOLS. I AND II—Prepared by the Aircraft Gas Turbine Development Dept., General Electric Co., Cincinnati. 1038 pp. McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 36. $75.00.

THERMODYNAMICS OF HEAT POWER—By Virgil Moring Faires. 432 pp. The Macmillan Co., 60 Fifth Ave., New York 11. $8.00.

MANAGEMENT FOR ENGINEERS—By Roger C. Heimer. 453 pp. McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 36. $6.75.

DETERMINATION OF DISSOLVED OXYGEN IN WATER—American Society for Testing Materials Headquarters, 1916 Race St., Philadelphia 3. $2.25.

SYMPOSIUM ON THERMAL CONDUCTIVITY MEASUREMENTS AND APPLICATIONS OF THERMAL INSULATIONS—88 pp. American Society for Testing Materials, 1916 Race St., Philadelphia 3. $2.75; to ASTM Members, $2.00.

ABRASIVE CUTTING AS AN UP TO DATE TOOL—Expanded to include "Which Abrasive Cut-Off Wheel Is the Right Wheel?" (Part III). Wallace Supplies Mfg. Co., 1300 Diversey Pkwy., Chicago 14. Three parts—$2.00

CODE AND MANUAL FOR THE DESIGN AND INSTALLATION OF WARM AIR WINTER AND YEAR-ROUND AIR CONDITIONING SYSTEMS—National Warm Air Heating and Air Conditioning Assn., 640 Engineers Building, Cleveland 14. $1.25.

CORROSION AND ITS PREVENTION—Prepared by the Corrosion Subcommititee of the Air-Conditioning and Refrigeration Systems Section of ARI. Air-Conditioning and Refrigeration Institute, 1346 Connecticut Ave., N. W., Washington 6, D. C. $.75.

NONDESTRUCTIVE TESTING SYMBOLS—American Welding Society, 33 W. 39th St., New York 18, N. Y. $1.00.

IT ROTATES!

- NO STEAM LEAKAGE
- NO WIRE DRAWING

TRERICE PATENTED STEAM TRAPS HAVE A ROTATING VALVE...ASSURING NO LEAKAGE DUE TO WIRE DRAWING

With every discharge, the valve in a Trerice trap seats in a different position . . . a new seat . . . a steam tight seat every time! Discharging water impinges on the impeller . . . causes rotating action.

EASIER MAINTENANCE

A Trerice trap can be inspected and cleaned without removing it from the line, or disturbing the high pressure bolts and gasket.

Removable cap permits quick access to valve and seat for inspection and maintenance.

FREE TRIAL OFFER

We'll supply one, a dozen, or more Trerice steam traps for your operation on a FREE 60-day trial basis. Act now! Write today for bulletin 1400D containing complete engineering data, valve and orifice charts.

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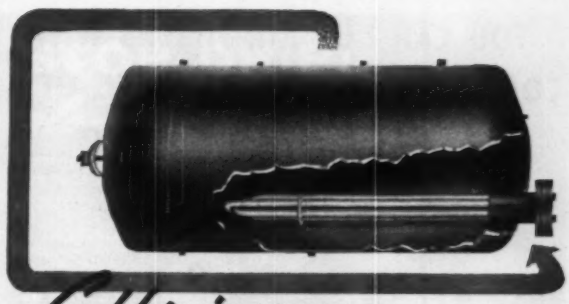
Sales Offices in Principal Cities of U.S.A. and Canada



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TANKS
SMOKESTACKS
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Here is a Hot Water Generator that will give you the maximum in efficiency! *More* hot water at *less* operating cost. Quality of constructions is your assurance of the maximum operating efficiency from your FINNIGAN equipment. Adaptable to any type operation—built to your specification in capacities from 66 to 5,000 gallons, FINNIGAN Hot Water Generators are made from the finest material and contain copper removable-coil heating element. They are equipped with large size tappings which can be bushed to fit any job.

Call, wire or write today for further information . . . there is no obligation.

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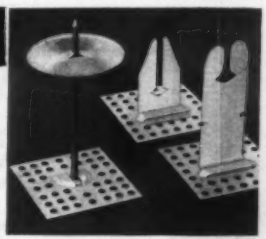
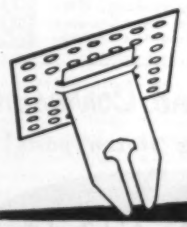


FASTER — EASIER — COST LESS!

Anchors by *Stic-Klips*®



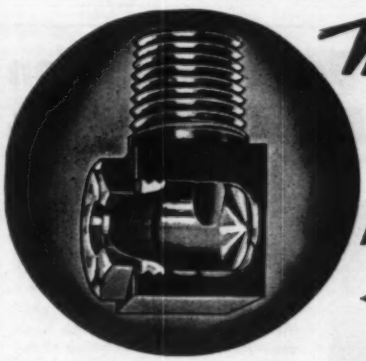
Stic-Klips® are time and labor saving anchors and fasteners for attaching insulation, strapping, metal lath, wall fixtures, wiring and conduit to curved or flat metal or masonry surfaces. Stic-Klips® feature no surface drilling, quick fastening, no fire hazard and a strong positive bond.

Send for free illustrated folder.

Stic-Klip®

MANUFACTURING CO., INC.
78 Regent Street
Cambridge 40, Massachusetts

Ask about the time and labor saving 5-Second application method.



Monarch

NOZZLES for AIR WASHERS

These are "non-clogging" nozzles with a single large tangential lead hole to the swirl chamber that will never clog from any impurities small enough to pass through the orifice. Swirl chamber is conical on both ends and pivots liquid like a top to produce an exceptionally fine, evenly distributed, balanced spray of about 80° included angle. Wider spray angles up to 130° can be furnished to order.

Standard material Brass. Also available in Stainless Steel and Monel. Pipe sizes from ⅛" to 1". ¼" size is 1-5/16" long and made from ⅝" square stock.

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New York 16, New York

Air Filter Corporation
108 N. Water Street
Milwaukee 5, Wisconsin

Air-Maze Corporation
25000 Miles Road
Cleveland 28, Ohio

American Air Filter Co., Inc.
215 Central Avenue
Louisville 8, Kentucky

Continental Air Filters, Inc.
2520 Helm Street
Louisville, Kentucky

Dollinger Corporation
20 Centre Park
Rochester 3, New York

Drico Industrial Corporation
100 Eighth Street
Passaic, New Jersey

Minneapolis-Honeywell Regulator Co.
Minneapolis 8, Minnesota

Owens-Corning Fiberglas Corporation
1833 National Bank Building
Toledo 1, Ohio

Pittsburgh Plate Glass Company
Fiber Glass Division
One Gateway Center
Pittsburgh 22, Pennsylvania

Research Products Corporation
1015 E. Washington Avenue
Madison 10, Wisconsin

*Technical Filter Co.
2719 South Poplar Avenue
Chicago 8, Illinois

Trion, Inc.
1000 Island Avenue
McKees Rocks, Pennsylvania

Vortex Company
121 S. Alexander Avenue
Claremont, California

Westinghouse Electric Corporation
Sturtevant Division
Hyde Park, Boston 36, Massachusetts

*Formerly Wilson & Co., Inc.

NEW BOOKS & REPORTS

Continued

PROBLEMS IN THE DEVELOPMENT OF THE BCR AUTOMATIC COAL-FIRED PACKAGED STEAM GENERATOR—By Paul O. Kock. 12 pp. Bituminous Coal Research, Inc., 121 Meyran Ave. at Forbes, Pittsburgh 13. $.35.

METHODS OF TESTING THERMOCOUPLES AND THERMOCOUPLE MATERIALS—By Wm. R. Roeser and S. T. Lonberger. 21 pp. U. S. Department of Commerce, National Bureau of Standards, Washington 25, D. C. $.20.

FACTORS AFFECTING BASEBORD RATING TEST RESULTS—By Warren S. Harris. 22 pp. Engineering Experiment Station, University of Illinois, Urbana, Ill. $.50.

AMERICAN STANDARD LETTER SYMBOLS FOR HEAT AND THERMODYNAMICS—14 pp. American Society of Mechanical Engineers, 29 W. 39th St., New York 18.

SHEET AND PLATE PRODUCT INFORMATION—308 pp. Kaiser Aluminum & Chemical Sales, Inc., 919 N. Michigan Ave., Chicago 11.

COUNTERFLOW COOLING TOWER PERFORMANCE—85 pp. J. F. Pritchard & Co. of California, 4625 Roanoke Parkway, Kansas City 12, Mo.

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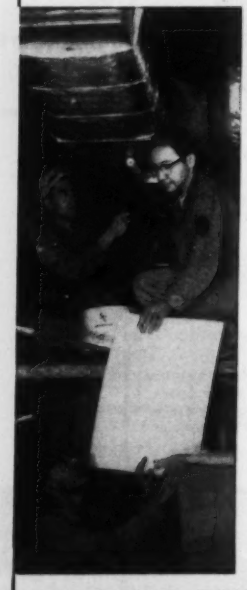

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Aggressive Sales Engineers desired for following metropolitan areas: Chicago — Milwaukee — Kansas City — San Francisco — Denver — Los Angeles — St. Louis — Oklahoma City — Dallas — Philadelphia — Omaha — Charleston, W. Va. Must contact P & H wholesalers and have following among architects, engineers and mechanical contractors. Exclusive territories available for this high quality line of commercial, industrial and institutional heating equipment; including school unit ventilators, finned tube radiation and commercial and residential baseboard. Address Key 1355A, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2, Ill.

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TOP REPRESENTATION available in Michigan area. Fully experienced in Plumbing, Heating, Ventilating, Fire Protection and Industrial Sales Fields. 7 years sales with W. T. Andrew Co., 2 years with leading Industrial Mech. Contractor, 4 years field experience. Mechanical Engineering, U. of D. Well known by Jobbers and throughout the trade. For top, aggressive representation, contact B. C. Doetsch & Associates, 19323 Coyle, Detroit 27, Michigan.

Manufacturer of diffusers and registers seeks representatives in limited number of territories. Engineering degree or equivalent. Reply Key 1354A, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2, Ill.

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HEATING & SHEET METAL business in northern Illinois industrial city over 100,000 pop. Shop completely equipped for sheet metal work required in heating, ventilating, air conditioning, etc. Excellent opportunity to acquire going business without the heavy investment of time and money required in a new venture. Address Key 1352A, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2, Ill.

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IDENTIFICATION NAME PLATES for controls and panels — precision engraved on bakelite or black anodized alum. — any titles — quick service by mail on small or large jobs — send for sample and prices. ATLANTIC ENGRAVERS, INC., 52 Ocean Ave., Amityville, N. Y.

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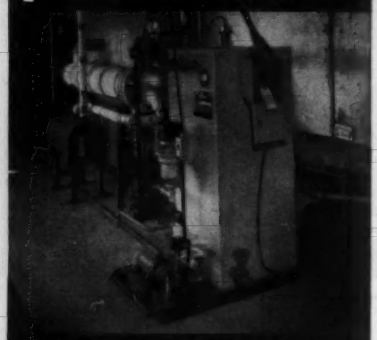
Your job will be a lot easier if you'll keep the January Directory number of Heating, Piping & Air Conditioning constantly available for handy reference. It's one of your most valuable tools — one which will save you many hours of looking up the products you need for your various jobs. It's the ONE complete, up-to-date, readily accessible source of product information on who makes the pumps, valves, traps, etc., you need — and where they're located. They're identified by trade names, too. EVERY product is listed, alphabetically arranged and printed on a distinctive yellow stock for easy reading and reference. Keep it handy . . . it's a time saver.

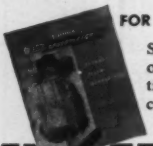
Pantex SPEEDYLECTRIC STEAM GENERATOR



Ideal Answer to
10 PROBLEMS
in Supplying Steam

- **Without flame, flues or stack**
- **At higher pressures or temperatures**
- **At adjustable pressure or temperature**
- **With a constant high quality**
- **Without long steam lines**
- **To serve summer processing needs**
- **To meet extra load needs**
- **For lab, test, or pilot-plant use**
- **Where an unattended boiler is desired**
- **Where boiler space is limited**

In many such situations, a Speedylectric Steam Generator is the best or only solution. Using the electrode method of generating steam electrically, completely safe anywhere, its design eliminates low-water hazard and practically removes the need for supervision. Generation is fast, by the simplest and most economical electric method, and adjusts automatically to meet load demand. Upkeep is nil . . . there are no coils, tubes or heating elements to scale or burn out. Sizes from 2 to 50 Bhp, 15 to 500 psi. Higher pressures are available. Electric power 220, 440, or 550 volts A. C. UL listed, ASME code.



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Send for Bulletin SG-100: operating principles, application features, detailed specifications for complete line.

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Send me Bulletin SG-100 . . . free

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*Title*_____

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*Address*_____

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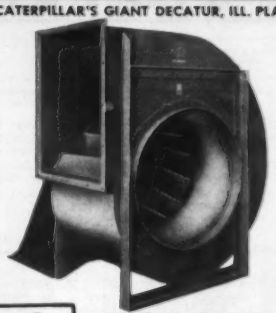
GENERAL BLOWER EQUIPMENT INSTALLED IN *NEW* Caterpillar PLANT

CATERPILLAR'S GIANT DECATUR, ILL. PLANT



TURBO BLOWERS

INDUSTRIAL FANS

CENTRIFUGAL FANS BACKWARD BLADE FORWARD CURVE

GENERAL BLOWERS ARE CUSTOM ENGINEERED

Non-Overloading Backward Blade Centrifugal Fan for Heating, Ventilating, Air Conditioning

In 1950 Caterpillar Tractor Co. bought 32 No. 6 DIDW General Blower Co. fans for their new Joliet, Ill. plant. The fans operated so successfully over a four and one half year period that Caterpillar installed 27 General blowers in their huge Decatur, Ill. plant. These fans move 1,220,000 CFM and fully meet all official ventilating requirements.

General Blower Co. manufactures a complete line of air moving equipment for heating, air conditioning, ventilating, industrial, and power plant applications.

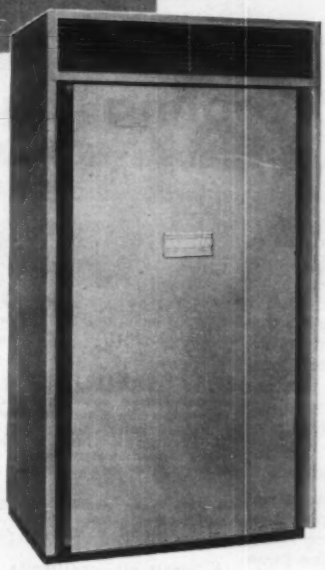
AMERICA BREATHES EASIER
"Lungs for Industry"

GENERAL BLOWER COMPANY
8610 FERRIS AVE., MORTON GROVE, ILL.

You can count on HIGHER PROFITS WITH Curtis AIR CONDITIONERS

Evaporative Condensers
and Cooling Towers
up to 100 tons
Air handling units to match.

Packaged Liquid Chillers—
7½ to 100 tons—F-12 or F-22.
With room console units to provide
controlled cooling and heating
without duct work.



Packaged
air conditioning
units—
3 through
50 tons.

Packaged Air Cooled Air
Conditioning Units—2
through 7½ tons. Residential
and commercial applications.

Condensing units up to
100 tons—F-12 or F-22.

HERE'S WHY...

MAXIMUM DEPENDABILITY

Each CURTIS unit is backed by 104 years of engineering and manufacturing experience . . . one of many reasons why CURTIS air conditioning equipment operates at maximum efficiency with a minimum of maintenance.

CUSTOMER SATISFACTION

The long operational life and minimum service requirements of CURTIS air conditioning, combined with peak performance, assures satisfied customers.

PRE-SOLD PROSPECTS

National advertising beamed at virtually every prospect category helps *pre-sell* Curtis equipment for you. CURTIS provides sales and promotional aids to make your selling job *easier*.

PRICED FOR PROFITS

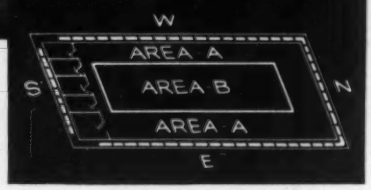
All Curtis air conditioning equipment is *competitively* priced, with a very generous profit margin *for you!*

REMEMBER—
you can count on **Curtis**

OUR 104th YEAR
MANUFACTURING COMPANY • REFRIGERATION DIVISION
1900 Kienlen Ave., St. Louis 20, Mo.

C-35

At the North American Life & Casualty Co., Minneapolis, Minn., KoolShade Sunscreen solves air conditioning problem shown at right: When Area A was comfortable, Area B was too cold; when Area B was comfortable, Area A was too hot.



SOLVED... the case of the "sun-struck" cooling system

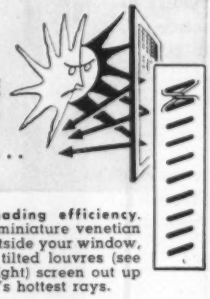
PEAK HEAT LOAD CUT 91 TONS BY KOOLSHADE

Problem: Diagrammed above, the problem faced by the North American Life & Casualty Building was one of air conditioning imbalance. When sun-exposed Area A was cool and comfortable, Area B was invariably too chilly. On raising the thermostat, Area B became comfortable ... but Area A would then swelter. Complaints abounded. And excess thermostat-activity was keeping the cooling unit in almost continuous operation.

Solution: KoolShade Sunscreen was installed on the sun-exposed windows.

Results: By screening out the sun's hot rays, KoolShade banished the solar heat from Area A ... thus permitting floor-wide uniformity of cooling. At the same time, KoolShade reduced by some 91 tons the peak load demand on the cooling unit itself. Running time was reduced ... with a substantial savings in operating costs! In addition, office-workers reported marked relief from eye-straining solar glare. And company officials were delighted with the improved appearance of the building.

Only **KOOLSHADE SUNSCREEN** *gives you...*



- **Unmatched shading efficiency.** Operating like a miniature venetian blind installed outside your window, KoolShade's tiny tilted louvres (see cross section at right) screen out up to 89% of the sun's hottest rays.

- **83% clear visibility.** KoolShade admits maximum glareless light • **Harmony with all architecture** • **Virtually no maintenance.**

- **Utmost air conditioning economy.** By common measure, 100 sq. ft. of KoolShade replaces the need for about one ton of cooling plant ... at substantial savings in cost.

Send today...

for the facts. Learn now how you can save with KoolShade. Return the coupon below.

KOOLSHADE®

REFLECTAL CORPORATION
A subsidiary of Borg-Warner Corp.
310 S. Michigan Ave., Dept. K-48
Chicago 4, Ill.

We'd like to know more about KoolShade. Without obligation, please send:

☐ Free literature
☐ Free sample

Name ..... Title .....
Company .....
Address .....
City ..... Zone ..... State .....

6295

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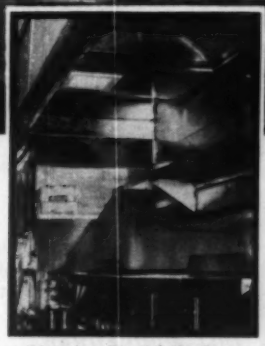
Skychef RESTAURANTS

AGAIN CHOOSE GALLAHER AIR-VANS ®

Sleek silhouettes are formed by these Gallaher Air-Vans atop Cleveland's new $12,000,000 air terminal which was completed in 1956.



Gleaming Skychef Kitchens, like this one in Cleveland's Hopkins Airport, are ventilated by Gallaher Air-Vans.

NEW CLEVELAND HOPKINS AIRPORT SERVICED BY GALLAHER EXHAUSTERS

At Cleveland's Hopkins Airport, Gallaher Air-Vans are installed atop the famous Skychef $750,000 restaurant and cocktail lounge. Air-Vans are already installed on Skychef Restaurants at Tulsa, Los Angeles, Rochester, Knoxville, Denver, and other American Airline passenger points.

Simplicity and durability...minimum maintenance...reliable performance. These are the big reasons why W. H. Hedick, engineering director for Skychef, chose Gallaher Air-Vans.

There are five Gallaher power exhausters, one direct drive, four belt drive, which serve Skychef kitchens, cocktail lounge, coffee shop and dining room. It's a big job, but Gallaher Air-Vans ventilate 16,000 square feet of floor space on three levels.

"We installed Gallaher exhausters at Cleveland because they gave us reliable performance at other Skychef Restaurants at major airports across the nation," said Mr. Hedick.

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Super-Strength Adhesives

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...fire-retardant adhesive for installing insulation

TUFF-BOND M-102-H

...economical duct liner adhesive

TUFF-BOND 21-C

...clear lap sealer and lap adhesive

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...white lap sealer and lap adhesive

TUFF-BOND #500

...exceptionally high-strength chemical-set adhesive with wide thermal range −100° F. to 400° F.

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...high heat resistance for bedding and installing high temperature insulation

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INCORPORATED
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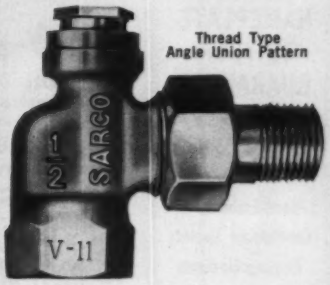
. . . these burly Sarco Balancing Fittings are extra-strong!

FOR USE UP TO 125 PSI
Every single one
TESTED AT 150 PSI!
Can be furnished with
INTEGRAL MANUAL AIR VENTS
All patterns also available in sweat-type.



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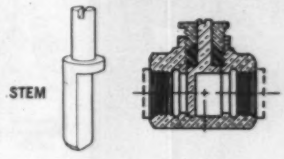
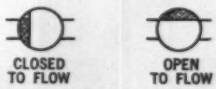
Angle Union Pattern

Thread Type
Straightway Union
Pattern

Straightway Screwed Pattern





Solid segment stem which insures linear straight flow

3219-B

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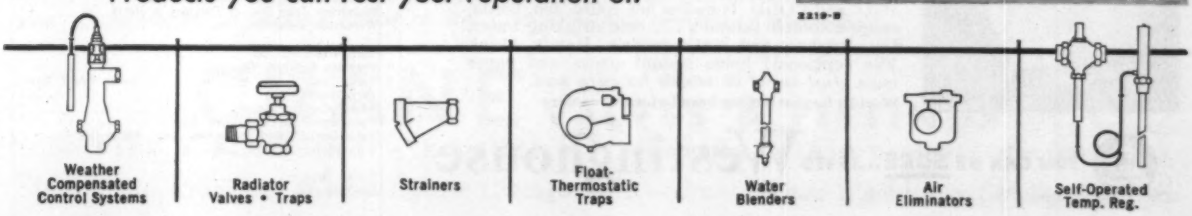

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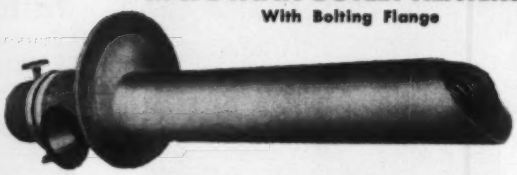

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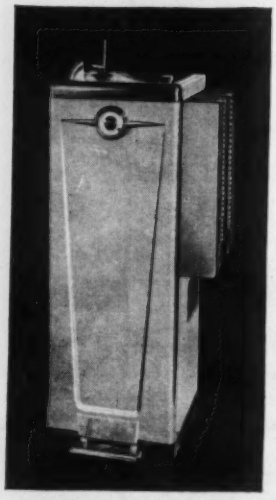

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Cut coffee-break time in half . . . save thousands of dollars every year . . . with this Westinghouse HOT and COLD. It makes hot coffee, tea, cocoa, soups available *instantly* . . . cold drinking water, too. Pressure and bottle models. Handy Drink File (optional) holds instant packs and paper cups. *Just one of 20 models for every need.*

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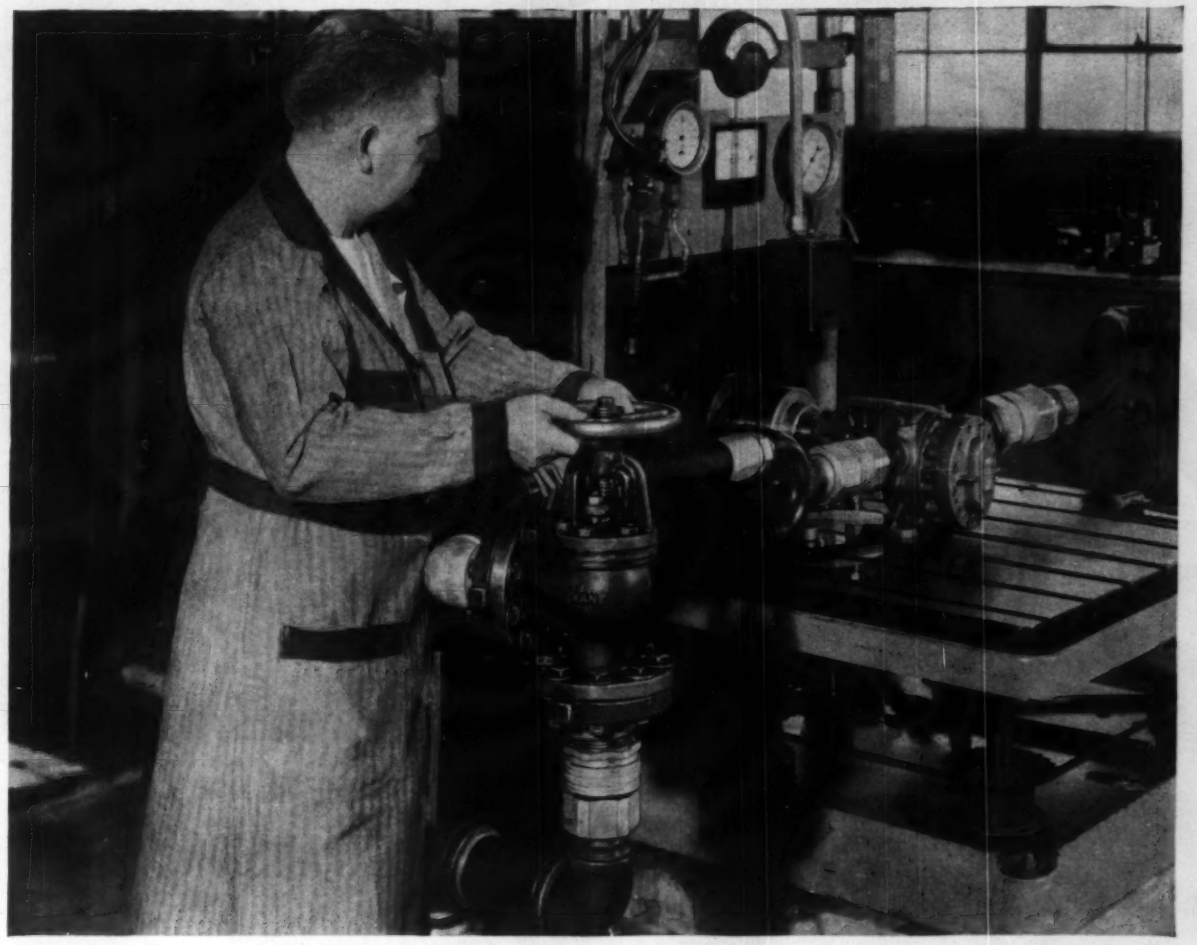

Uses CRANE valve on severe throttling for 23 years—without repairs

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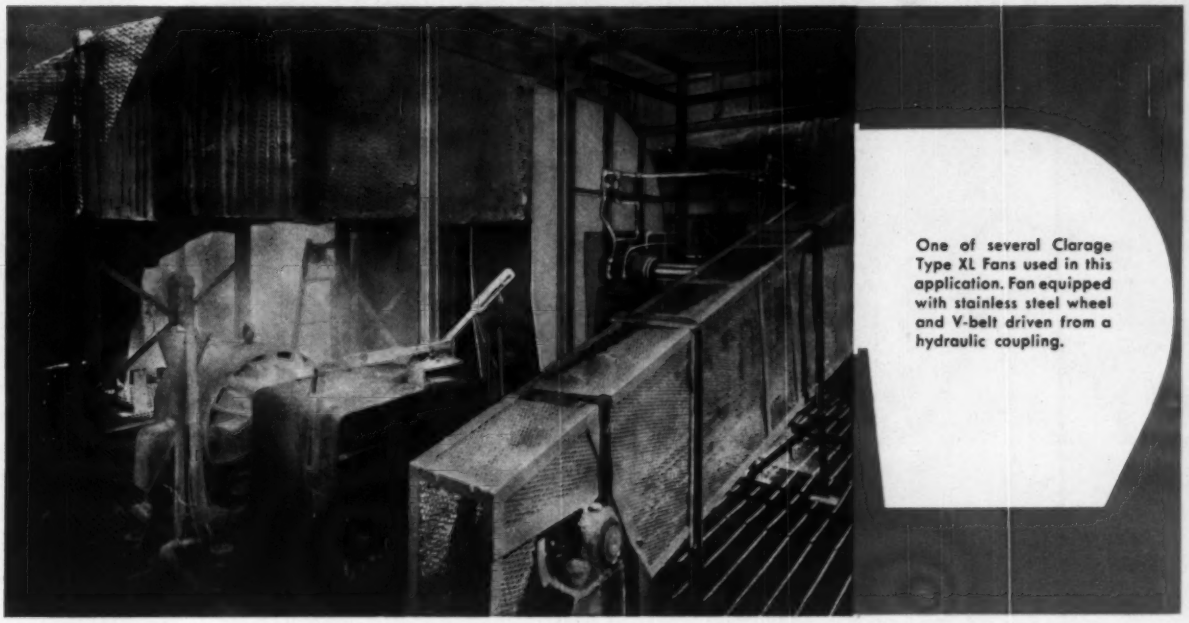

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for this tough exhaust assignment in the production of titanium dioxide

Exhausting 800° F gases from rotary calciners through scrubber units and electrical precipitators to the atmosphere.

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